INDEX NUMBER

AMERICAN JOURNAL OF ORTHODONTICS

OFFICIAL PUBLICATION OF
THE AMERICAN ASSOCIATION OF ORTHODONTISTS,
ITS COMPONENT SOCIETIES, AND
THE AMERICAN BOARD OF ORTHODONTICS

PUBLISHED BY THE C. V. MOSBY COMPANY, ST. LOUIS 3, U. S. A.

TABLE OF CONTENTS ON PAGE 2

Vol. 38 **DECEMBER, 1952** **No. 12**

Vol. 38, No. 12, December, 1952. American Journal of Orthodontics is published by The C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, Mo. Subscription price: United States, its possessions, Pan-American Countries, $10.00; Canada and Foreign, $11.00. Entered as Second-class matter, January 14, 1915, at the Post Office at St. Louis, Missouri, under the Act of March 3, 1879. Printed in the U. S. A.

CONTENTS FOR DECEMBER, 1952

American Journal of Orthodontics

Original Articles

In Memoriam

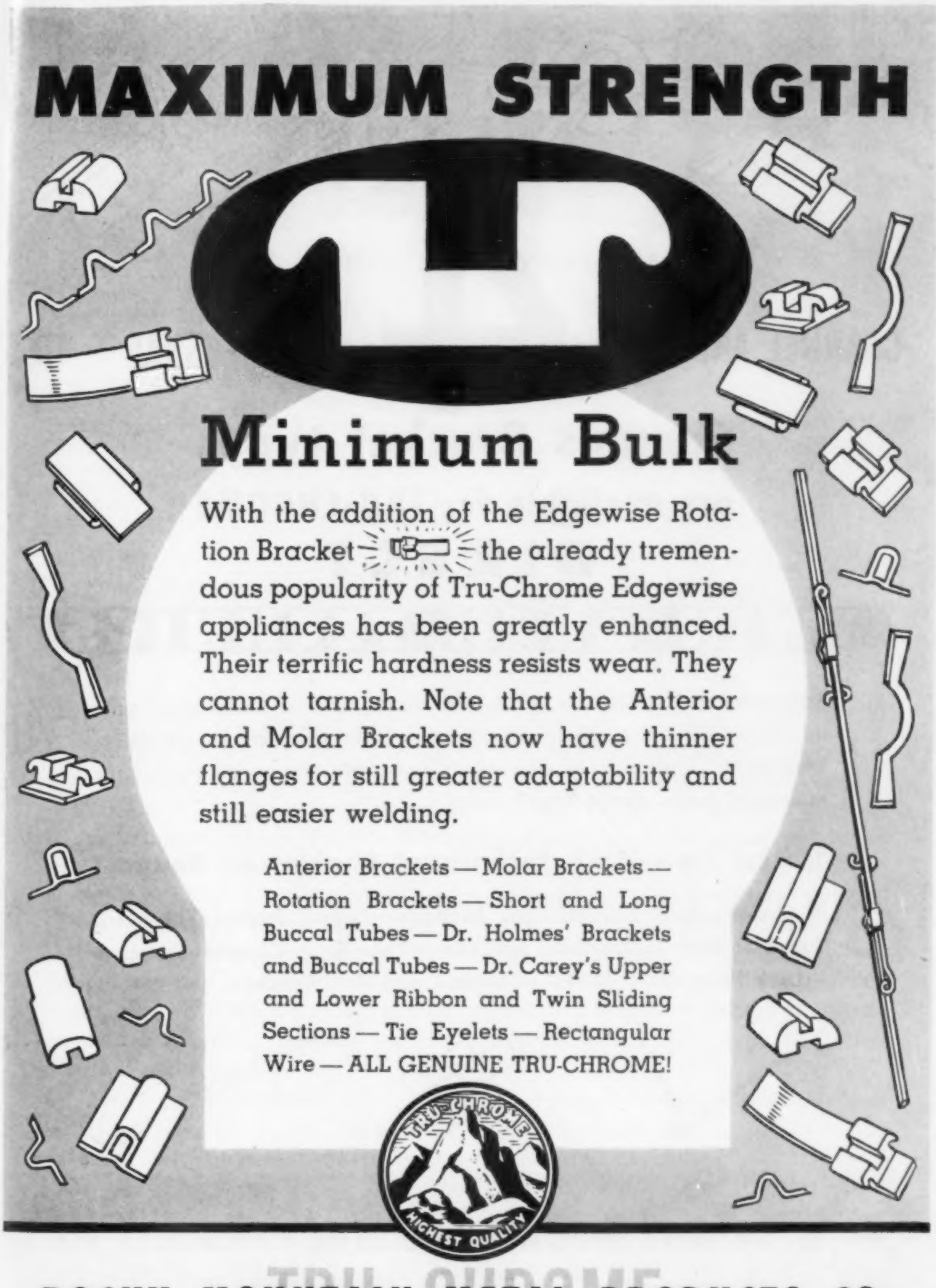
Orthodontic Abstracts and Reviews

News and Notes

Officers of Orthodontic Societies

Index

• THOSE directing the editorial and advertising policy of the magazine wish to remind the readers of the unusual care and scrutiny given the advertising messages appearing in these columns. In these times, when every publication is eager for advertising revenue, the advertising standards of this magazine have not been and will not be lowered or modified. These pages have been closed to many advertisers because their products, policies or methods did not conform with our requirements.


MAXIMUM STRENGTH
Minimum Bulk
With the addition of the Edgewise Rotation Bracket the already tremendous popularity of Tru-Chrome Edgewise appliances has been greatly enhanced. Their terrific hardness resists wear. They cannot tarnish. Note that the Anterior and Molar Brackets now have thinner flanges for still greater adaptability and still easier welding.
Anterior Brackets — Molar Brackets — Rotation Brackets — Short and Long Buccal Tubes — Dr. Holmes' Brackets and Buccal Tubes — Dr. Carey's Upper and Lower Ribbon and Twin Sliding Sections — Tie Eyelets — Rectangular Wire — ALL GENUINE TRU-CHROME!
TRU-CHROME
HIGHEST QUALITY
TRU-CHROME
ROCKY MOUNTAIN METAL PRODUCTS CO.
1450 Galapago Street • P. O. Box 1887 • Denver 1, Colorado
East Coast Distributors: Gilbert W. Thrombley, 220 W. 42d St., New York 18, N.Y.
West Coast Distributors: Karl A. Kreis, 443 Sutter St., San Francisco 8, Calif.
Export Department: P.O. Box 1051, Denver 1, Colo.

American Journal
of
ORTHODONTICS

VOL. 38 DECEMBER, 1952 No. 12

Original Articles

SYNCHRONIZING TREATMENT WITH DEVELOPMENT

WALTER J. SLY, D.M.D., BOSTON, MASS.

PROBABLY the weakest link in the diagnosis of dental anomalies is our inability to predict, with any degree of certainty, the amount of growth which will be attained by a given individual at the completion of his secondary dentition. Various methods have been devised to act as guides, those of Bogue, Stanton, Nance, Pont, and Hawley being indices of measurement, and grids such as devised by Wetzell indicating growth trends. Some of these methods establish arch measurements and ideal arch form for given amounts of tooth material, but do not aid us in predicting the ability of the individual to attain it. It may be helpful to examine the genetic background of our patient for any clues that may be suggested. There seems to be a growing trend toward a fatalistic attitude in regard to hereditary factors in dental anomalies, assuming that the pattern of growth is determined at conception and that nothing can be done to change it.

However, it should be borne in mind that every child is a completely new individual and not a composite of the physical and mental attributes of the parents. Wide differences exist between children of the same family. Indeed, the occlusal patterns of some biovular twins show little resemblance. It is true that the mechanism of linkage seems to bring out marked resemblances, but it is well to bear in mind that there is a complete shuffle and deal of genetic factors and a blending into a complete new individual. This is even more pronounced in a hybrid population such as ours. Nor do we get much help in the majority of cases from an examination of the congenital factors. Previous theories have indicated that dental anomalies may have been caused by

Read at the meeting of the American Association of Orthodontists, St. Louis, Mo., April 21, 1952.

American Journal
of
ORTHODONTICS

VOL. 38 DECEMBER, 1952 No. 12

Original Articles

SYNCHRONIZING TREATMENT WITH DEVELOPMENT

WALTER J. SLY, D.M.D., BOSTON, MASS.

PROBABLY the weakest link in the diagnosis of dental anomalies is our inability to predict, with any degree of certainty, the amount of growth which will be attained by a given individual at the completion of his secondary dentition. Various methods have been devised to act as guides, those of Bogue, Stanton, Nance, Pont, and Hawley being indices of measurement, and grids such as devised by Wetzell indicating growth trends. Some of these methods establish arch measurements and ideal arch form for given amounts of tooth material, but do not aid us in predicting the ability of the individual to attain it. It may be helpful to examine the genetic background of our patient for any clues that may be suggested. There seems to be a growing trend toward a fatalistic attitude in regard to hereditary factors in dental anomalies, assuming that the pattern of growth is determined at conception and that nothing can be done to change it.

However, it should be borne in mind that every child is a completely new individual and not a composite of the physical and mental attributes of the parents. Wide differences exist between children of the same family. Indeed, the occlusal patterns of some biovular twins show little resemblance. It is true that the mechanism of linkage seems to bring out marked resemblances, but it is well to bear in mind that there is a complete shuffle and deal of genetic factors and a blending into a complete new individual. This is even more pronounced in a hybrid population such as ours. Nor do we get much help in the majority of cases from an examination of the congenital factors. Previous theories have indicated that dental anomalies may have been caused by

Read at the meeting of the American Association of Orthodontists, St. Louis, Mo., April 21, 1952.

prenatal nutritional deficiencies, but it is now believed that, except in extreme cases, the developing fetus will take from the mother what it requires for its nutriment. This applies to mineral requirements and should not be construed as minimizing the importance of prenatal care.

Fig. 1.

Fig. 2.

Figs. 1 and 2.—Dental anomaly with corresponding facial asymmetry.

Intrauterine pressures seemed to offer logical explanations, but more recent investigations seem to discredit this theory except in rare instances. It is possible that the absorption of toxic substances through the placental circulation may have an effect upon development, but here again these instances would be rare with the possible exception of excessive use of alcohol and of tobacco by the mother during pregnancy.

There are, however, certain undetermined factors which lay the groundwork for dental anomalies in later stages of development. These factors are

similar in character to those which cause cleft palate and harelip, but vary in degree. This may be a somewhat speculative theory but we do see evidences which point in this direction; for example, bifurcated uvula, asymmetries in the palate, and other defects in the formation of the jaws (Figs. 1, 2, and 3).

With this background in mind we attempt to make an appraisal of our patient and determine, if possible, his chances of attaining normal development. Certain of our patients seem to be normal individuals with dental anomalies, to be sure, but otherwise quite normal. Others fall into a class which might be termed constitutional defectives and seemingly with the growth impulse very feeble and lacking in vigor. In appraising these individuals we must keep constantly in mind that each has his individual growth capacity, and, although he will not attain our concept of the normal,

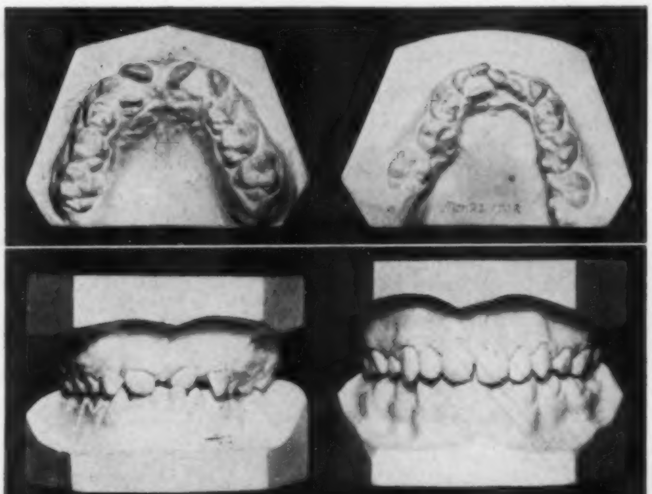


Fig. 3.—Bifurcated uvula associated with dental anomaly.

nevertheless, given optimal conditions of growth he will reach a stage which is the best of which he individually is capable. These individuals cannot be culled from our practice as would be the case in animal husbandry, but they must be given every opportunity to develop their potential for growth. We have then two choices: we may allow nature to take its course, or we may endeavor to assist nature during the early stages of temporary dentition and transitional period.

In an abridged form Conklin defines development as a progressive and coordinated differentiation of the organism under the influence of heredity and environment. The hereditary and congenital factors, although of vital importance, are "water over the dam" and we must turn our attention to any influences which we may bring to bear upon the environment.

Having appraised our patient to the best of our ability, it becomes necessary to eliminate all factors which might tend to retard or interfere with

growth and encourage any factors which promote it; for example, if the child shows evidences of faulty metabolism this should be corrected. Specifically, if any signs of nutritional disturbance or deficiency are recognized he should be given suitable treatment. Even though there may not be any immediate correlation between nutritional disturbance and growth deficiency, there seems to be some reason to believe that there is a delayed reaction or "time bomb effect" which becomes evident at a considerably later period of growth. Or if any endocrine syndrome is suspected, particularly one involving the pituitary or thyroid, the pediatrician should be consulted. Having done this, what can we as orthodontists do to promote the growth of this patient toward his individual normal?

The announced purpose of this presentation is to demonstrate the advisability of keeping the dentition within the normal physiological limits for the age of the individual. It is necessary then to recognize what these limits are, as well as certain conditions which may appear to be malocclusions, but which actually are stages of growth. To cite just a few: the diastemas appearing between the maxillary incisors; the apparent rotation and tipping of the lateral incisors during the eruption of the cuspids; various stages of migration in the molars during transition; overbite in mixed dentitions due to wearing of deciduous teeth; and all those apparent disproportions during the ugly duckling stage which resolve themselves without interference. These do not interfere with growth and should be kept under observation only. There are, however, certain conditions which should be corrected in the early stages, and our yardstick in these cases should be: "Does it interfere with function or retard growth?"

Our yardstick, as mentioned, should be applied to the deciduous and mixed dentitions; and if conditions exist which interfere with function or retard growth they should be corrected. Indeed, some corrections must be made at this time or the opportunity will be lost. I believe there would be much less concern about bimaxillary protrusions if some of these corrections were made early.

The dentition may be compared to a biennial plant which attains its growth in the green stage, but does not bear fruit until the stalks have become set and taken on a woody structure. Changes of form may be made in the green stage in either plant or bone, but are sharply limited after the wood has formed or the bone mineralized. Many of our patients acquire a certain set of their jaws during this pubescent period which indicates that the bone has reached this stage in its development where the trabeculae have been formed and become calcified.

Dr. Harry Sicher states that the alveolar portion of the jaws is completely replaced with new bone between the first and the second dentition. A diagram from Sicher's book shows the direction of these trajectories which, in general, are placed to withstand the forces put upon them by the muscles. With this in mind it would seem important that the forces of mastication, in fact of all

the muscles that are involved in the development of new bone, should be kept within normal limits in order that this new trabecular pattern shall be laid down along normal lines of force (Fig. 4).

Also when we speak of basal bone the term must be confined to the secondary dentition as there seems to be little base when the body of the bone is occupied by developing follicles and the osteogenic tissue which surrounds them.

The arch form should be restored so that it is possible for the child to place his jaws in their normal relation with the individual teeth in a position of mechanical advantage. This should be accomplished by the simplest mechanical means at our disposal and exercises should be prescribed to maintain this correction and restore functional activity to normal.

Fig. 4.

Relative to restoring the form and relation of dental arches, it may not be amiss at this time to discuss an adaptive mechanism which nature uses to protect the teeth against trauma and maintain a comfortable occlusion. If one or more points in a dental arch are displaced so that the arches when placed in a normal relation would cause an interference, the muscles involved are relaxed and the jaws adjust themselves to a position which protects the offending tooth from damage through trauma. We see many examples of this in developing dentitions, and often a slight correction will tend to restore the arches to their normal relation. Most common examples of this are in Class II relationship where the mandible assumes a distal position because of a

rotated incisor or instanding cuspid. The mechanism involved which allows this adjustment to take place is a delicate one whereby the interference stimulates the tactile organs in the periodontal membrane which in turn causes the pterygoid muscles to relax. This can be bilateral or unilateral. A common example is an interference in one cuspid which causes a unilateral distoclusion on the opposite side. Other examples of this in developing dentitions manifest themselves as cross-bites and other forms of malocclusion.

One condition which has been quite prevalent recently is a man-made interference caused by the insertion of temporary acrylic crowns usually for the repair of broken incisors. Whereas the normal tooth form would be concave to allow for the lower incisors, these are convex and thick at the incisal edges, thus causing a protrusion of the maxillary incisors and sometimes a distoclusion of the mandible.

The position of mechanical advantage referred to previously herein is one in which the cusp relation is normal in the horizontal plane, but in which the teeth may not have attained sufficient length to complete the interdigitation.

A discussion of function should be divided into three main parts: dysfunction, malfunction, and perverted function, or habits. The first is a condition in which the muscles have become weakened through lack of use; the second is usually associated with a malocclusion as the temporal muscle in a Class III condition; the third is a misdirected muscle action as in the case of tongue thrust or other habit.

Our goal in the program of myofunctional therapy is to train the muscles with reference to the direction of their force as well as the establishment of a normal tone level. It is not our intention to give these children overtrained bulging muscles, but to raise the level of the resting tone. It is not possible to explain in detail the difference between a phasic, or voluntary, and a tonic contraction of the muscles except to say that the strength of a phasic contraction depends upon the number of fibers in action, whereas the tonic contraction varies with the frequency of the impulse. It may clarify the correlation between tone and muscle exercise to quote from a previous paper on myofunctional therapy:

RELATION OF TONE TO FUNCTION

Control of muscle tone is involuntary in the generally accepted sense. There is, however, one qualification which must be made to this statement and herein lies the essence of the rationale of myofunctional therapy. In addition to the two divisions of the nervous system which have been mentioned, there is a third division which must now claim our attention since it is through this mechanism that the voluntary activity of myofunctional therapy is able to influence the involuntary function of tone. There are located in the tendons and joints, highly specialized nerve endings which are stimulated when the muscle or bone is in motion. These are the organs of kinaesthetic or proprioceptive sense, which keep the individual conscious of his position in space, his rate of motion, balance, etc. Special afferent fibres pass from these end organs to a section of the spinal cord known as Clark's column where they unite to form the "direct cerebella tract." This tract or bundle of fibres passes directly to the cerebellum where they ter-

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

minate in the centers of tone control. Conscious activity concentrated in certain muscle groups as in myofunctional therapy stimulates these tone centers and causes an increase in the frequence of the nerve impulse and consequent rise in tone level. Like most sequence of cause and effect the interaction of tone and function is circular in character and when once established tends to continue. It has been noted how increase in function raises tone level, and it is equally true that a high level of tonicity increases functional activity. The athlete, poised or set for a contest, has in his muscles an alertness and readiness for activity because of their well toned or trained condition. It has also been observed that his muscles have increased their tone as a result of strenuous effort. Thus it is evident that the effect of muscle training does not end with the actual exercise period, but continues in its stimulatory effect to create a capacity for the more vigorous use of the parts at all times.

Fig. 9.—Treatment delayed until 13 years of age.

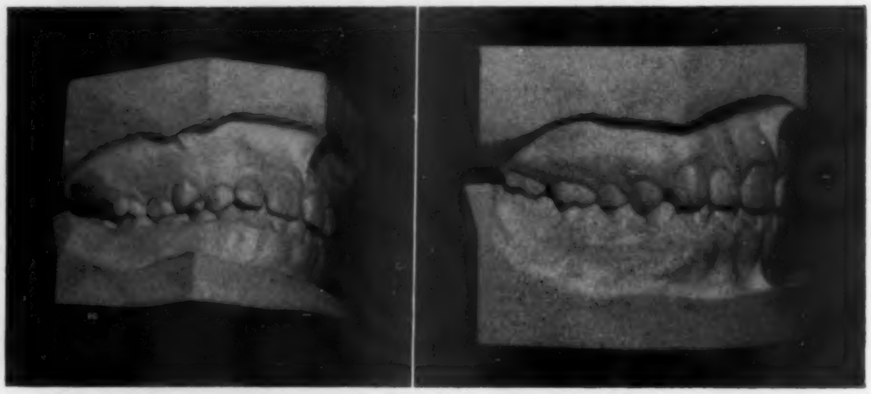


Fig. 10.—Treatment not needed to correct cross-bite.

When we speak of poise, facial expression, presence, carriage, and posture we are referring to well-balanced frequency of muscle tone. It is a correct posture of oral and facial muscles for which we strive (Figs. 5, 6, and 7).

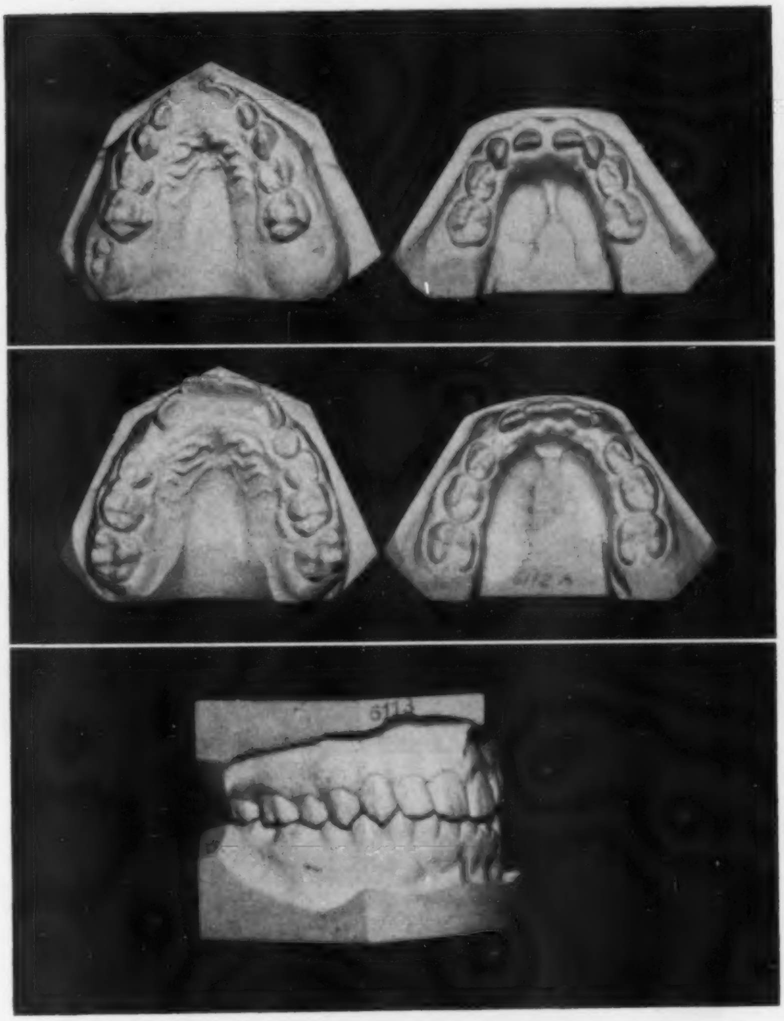


Fig. 11.

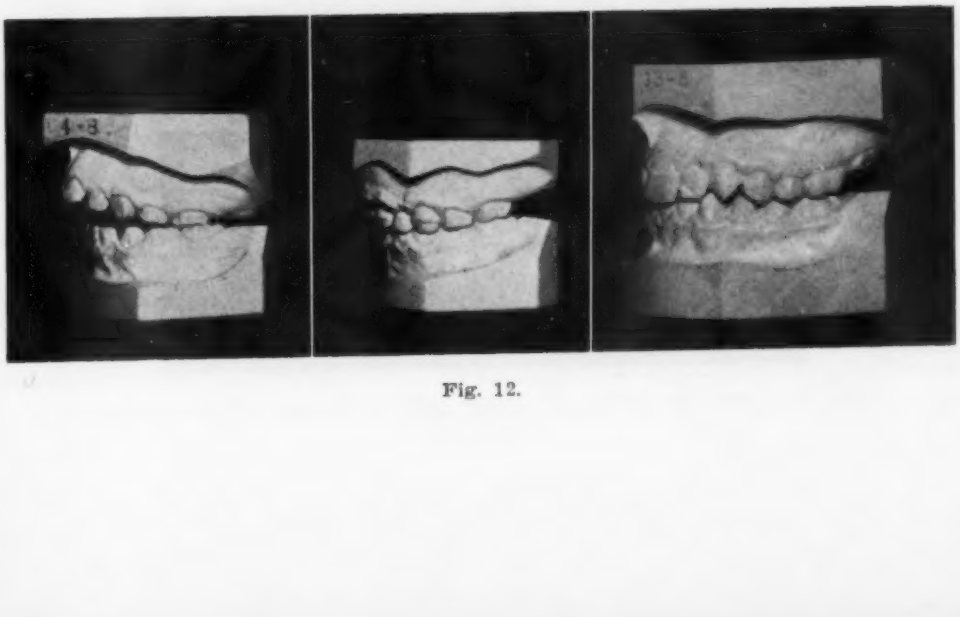


Fig. 12.

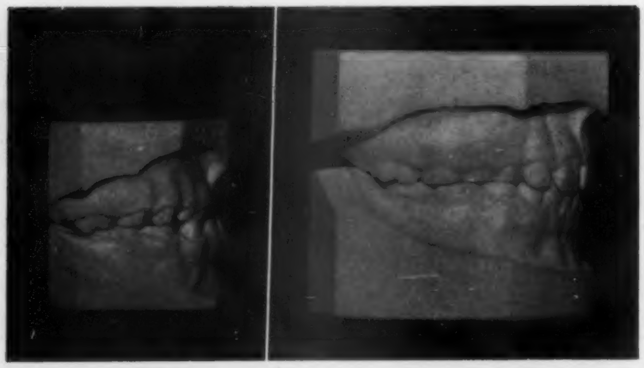


Fig. 13.—Treatment synchronized with growth in Class III case.

Fig. 14.

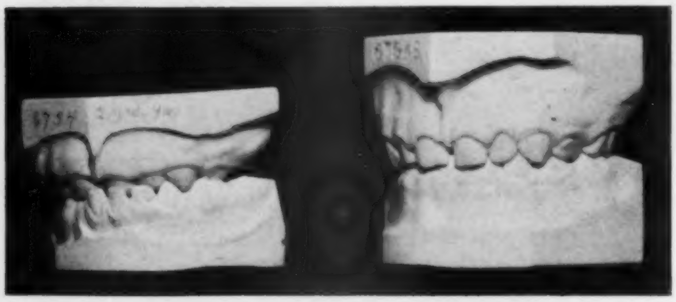


Fig. 15.

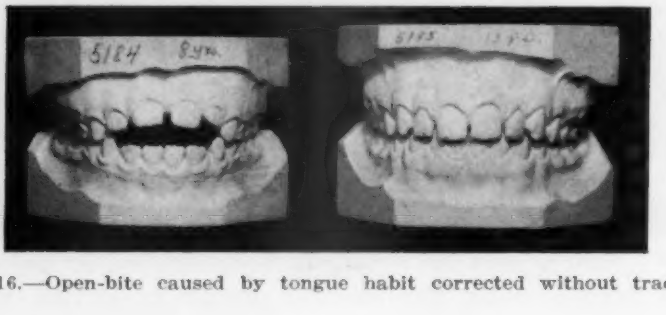


Fig. 16.—Open-bite caused by tongue habit corrected without traction.

The reason for this rather long quotation is to correct the impression that exercise affects growth during the exercise period only. Dr. Gesell, in his book *The Child From Five to Ten,* states: "Posture remains a key concept for adequate interpretation of child development."

A.

B.

Fig. 17.—*A* and *B*, Important to correct position of lateral incisor before eruption of cuspid.

One important factor which should be considered in this connection is the establishment and maintenance of a normal function at the earliest possible age, keeping in mind the influence of this factor upon the existing growth pattern.

We recognize that function will not change the basic pattern of growth but will modify it considerably when its influence is exerted *early* and during periods of *active* growth.

Habits as they are related to dental anomalies are mainly perversions of function and should be corrected as early as possible. This is a subject in itself and will not be dealt with in detail, except to point out one or two points which seem important and which have not been emphasized in the literature; for example, in the habit of thumb-sucking the emotional satisfaction which the child derives is not from the thumb or finger but from the visceral sensory nerve endings in the tongue or lips. These sensations are diffuse and spread through the visceral nerve components by means of chemical mediators to the centers which govern the emotions.

Another point which has received little attention, until mentioned by Dr. Clifford G. Glaser, in a recent paper, is the fact that the sucking reflex is succeeded by the chewing reflex. It is important, therefore, in treating these patients to develop the muscles of mastication and include those items in the diet which demand vigorous mastication. I do not recall a case involving a sucking habit in which the muscles of mastication were vigorous and well developed. The early correction of oral habits is also important from the standpoint of its effect upon the soft tissues. The imprint of the upper incisors upon the lower lip may sometimes be seen long after the malocclusion and the habit have been corrected.

Growth and development are often mentioned together as if they were part of the same process, but sometimes during the transitional period they must be considered separately. You will recall that development was described as progressive and coordinate differentiation, but growth is defined as the augmentation of the body through cell proliferation. In order for the individual to develop normally these two processes should be synchronized, but we see many examples of faulty timing, one of the more frequent involving the eruption of teeth. Sicher states that eruption has little effect upon growth, but that growth seems to affect eruption considerably, and we see instances of delayed eruption of permanent teeth that seem to point in this direction. Treatment in these cases consists in either extraction of overretained teeth or maintaining space for late erupting teeth (Fig. 8).

There are, in addition to those cases which we mentioned earlier as phases of normal development, certain borderline cases which, although they are anomalies, seem to be improving. Correction of these cases may safely be postponed and the time of active treatment considerably shortened (Figs. 9 and 10).

Those conditions which according to our yardstick are interfering with function or retarding growth should be treated as early as discovered (Figs. 11, 12, 13, 14, 15, and 16). Still others are timed to coincide with certain phases of development (Figs. 17, *A* and *B*, and 18).

So-called forced bites which actually are not forced, in which the mandible is deflected distally by interferences as described previously, often a rotated or retruded incisor, respond quickly when these conditions are corrected.

Most diastemas between the maxillary central incisors close spontaneously, but when the frenum is very heavy and the space has not closed by the time the maxillary cuspids are nearly in position the attachment should be dissected and the scar allowed to heal as the maxillary cuspids assume their final position (Fig. 19).

The distinctive feature of some anomalies is the lack of vertical development. The timing factor is important here, and advantage should be taken of the active growth in molar and premolar regions.

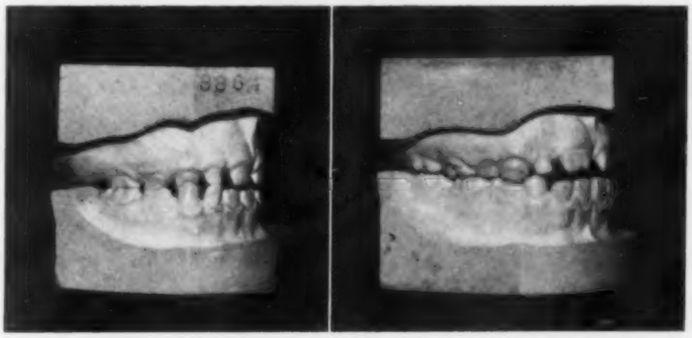


Fig. 18.—Correction synchronized with eruption of 6-year molars.

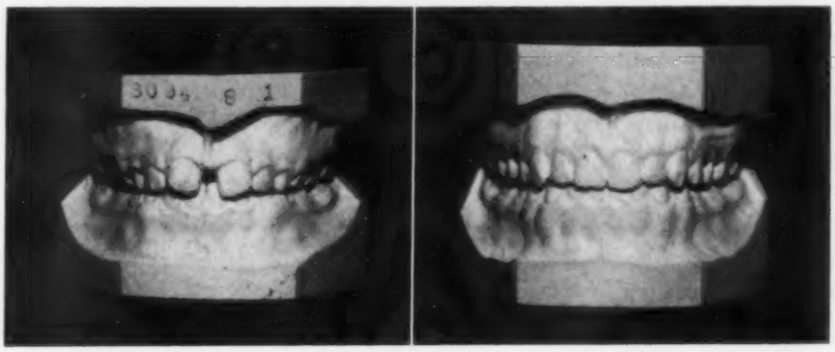


Fig. 19.

An attempt has been made in the text to direct attention to individual growth capacity, and to suggest that the removal of interferences and restoration of function at an early age, and at strategic periods of active growth, will compensate in a measure for earlier deficiencies and help attain an individual normal.

Mention was made of certain conditions which were within physiologic limits; others which correct spontaneously; a third group which should be treated as early as possible; and, finally, the group which should be synchronized with growth.

Some emphasis was placed on the maintaining of function during the transitional period, together with an explanation of some phases of muscle physiology.

The parent understands that the purpose of early treatment is to simplify treatment, not eliminate all treatment of the second dentition.

No attempt is made to force growth beyond the normal for the physiological age of the patient.

Slight variations are frequently kept under observation to note trends of growth.

The slides were selected to illustrate the advantage of synchronizing treatment with growth under the various classifications.

REFERENCES

Conklin, E. G.: Heredity and Environment, Princeton, N. J., 1917, Princeton University Press.
Gesell, Arnold, and Ilg, Frances: The Child From Five to Ten, New York, 1946, Harper & Brothers.
Sicher, Harry: Oral Anatomy, St. Louis, 1949, The C. V. Mosby Company.
Sly, Walter J.: Myofunctional Therapy, INT. J. ORTHODONTIA **23**: 572, 1937.

60 CHARLESGATE WEST.

A PARTIAL HISTORY OF THE SOUTHERN SOCIETY OF ORTHODONTISTS

OREN A. OLIVER, D.D.S., L.L.D., NASHVILLE, TENN.

DR. CLINTON C. HOWARD and I were attending the meeting of the American Society of Orthodontists in Atlantic City. The meeting was rather a "hot" meeting and lots of discussion took place. After the meeting was over Dr. Howard and I left for our homes. We arrived in North Philadelphia and had to wait for the train for about two hours. While walking around North Philadelphia I said to Dr. Howard, "Let's organize a Southern Society of Orthodontists." This was the first time Dr. Howard had attended a meeting of the American Society of Orthodontists. Dr. Howard agreed that it was a good idea and we then caught trains for Nashville and Atlanta. While attending the meeting of the Thomas P. Hinman Mid-Winter Clinic which was being held in the Piedmont Hotel in Atlanta, Ga., Feb. 23, 1921, we called together a group of men for the organization of the Southern Society of Orthodontists. These were the charter members and are as follows: Drs. C. C. Howard, J. A. Gorman, Oren A. Oliver, Thomas T. Moore, Jr., Thad Morrison, Donald Morrison, H. L. Parks, Wyatt B. Childs, C. C. Johnson, and Wm. C. Fisher, of New York City. Dr. Wm. C. Fisher, being from New York City, and not in the exclusive practice of orthodontics, could not be listed as a charter member, that is, as an active charter member, but we elected him an honorary charter member. He was the first honorary member of the Society. We met in the Piedmont Hotel for the purpose of organizing the Society. The following were unanimously elected as officers: C. C. Howard, President; J. A. Gorman, Vice-President; O. A. Oliver, Secretary-Treasurer. A motion was then made that the name of this Society be the "Southern Society of Orthodontists."

At this time we had no constitution and bylaws. As a consequence a committee was appointed to formulate a constitution and bylaws to be sent out to each member of the Society at least one month before the next meeting in order that we could familiarize ourselves with the bylaws and constitution. A committee was appointed to draft the bylaws and send them out. The membership was limited to only those who were in the exclusive practice of orthodontics. A motion was made then and carried that the dues be $10 a year payable on January 1 of each year. The motion was made and carried that each member should present a paper, clinic, or case report at each meeting. At this meeting Dr. J. Lowe Young, of New York City, gave a very interesting talk on "Orthodontia and the Future of This Society."

Read before the Southern Society of Orthodontists, Asheville, N. C., Aug. 13, 1952.

The first annual meeting was held in Atlanta, March 14, 1922, at which time the bylaws and constitution were adopted. At this time there was considerable discussion in regard to use of the words "exclusive practice." Nevertheless it was approved. The motion was made by J. A. Gorman that a fee of $1.00 be charged as initiation fee. The motion was carried. The Board of Censors was adopted more or less along the lines of the American Society of Orthodontists. I believe you will agree with me that the Board of Censors has been a wonderful Committee throughout the many years the Southern Society of Orthodontists has been in existence. They have done a remarkable piece of work throughout these years. The first Board of Censors was composed of Dr. C. C. Howard for three years, Dr. Herbert C. Hopkins for a term of two years, and Dr. Raymond R. McDaniel for one year. These three men were elected unanimously.

Dr. C. C. Howard gave a very interesting address, then introduced Dr. John V. Mershon, of Philadelphia, who gave a paper on "Physiology and Mechanics in Orthodontia." Clinics were given by Dr. Mershon, Dr. E. N. Lawrence, Dr. H. L. Parks, Dr. J. A. Gorman, and Dr. H. C. Hopkins. In the evening Dr. Horace Elkin, of Atlanta, gave a paper, "The Study of Dental Arches as Related to Endocrine Balance With Classifications Pertaining to General Metabolic Changes," with lantern slides. Thursday morning Dr. Newton Craig, of Atlanta, gave a paper on "Intra-Nasal Deformities Resulting From Mal-Development." Dr. J. A. Gorman gave a paper on the "Importance of X-Ray in Diagnosis." At this meeting Dr. W. C. Fisher, of New York City, announced that he had an invitation from the INTERNATIONAL JOURNAL OF ORTHODONTIA AND ORAL SURGERY to accept it as the official organ for the proceedings of the Southern Society of Orthodontists. The motion was made and the JOURNAL became the official organ of the Southern Society. At this meeting Dr. John V. Mershon was elected an honorary member of the Society.

In 1923, on January 22, the meeting of the Southern Society was held in New Orleans and Dr. J. A. Gorman was the president. A number of clinics and papers were presented at this meeting. An interesting paper was given by Dr. L. R. Debuys of New Orleans on "Influence of Nutrition on the Development of the Teeth." Also a paper was given on "The Physiology of Tissue Changes" by Prof. Harold T. Mead of the Department of Zoology of Tulane University. The total amount of cash in the treasury at this meeting was $126.95.

The third annual meeting was held in Nashville, Tenn. Dr. O. A. Oliver was the president. Men were taken in at each meeting from the beginning; however, at this meeting quite a large number joined the Society. Dr. LeRoy Johnson, of Ann Arbor, Mich., presented a paper on "The Early Treatment of Malocclusion of the Teeth." Dr. W. G. Kennon, of Nashville, Tenn., read a paper entitled "Some Points of Relationship Between Orthodontia and Surgery of the Ear, Nose and Throat." Dr. John W. Lee, of Nashville, read a paper, "Dietary Habits of Children." Dr. Harry E. Kelsey of Baltimore then read a paper, "The Future Consideration of Some Phases of the Treatment of Cleft

Palate.'' Dr. R. C. Derivaux, of Nashville, presented a paper, ''Some Biological Considerations of Growth and Development and Their Relation to Orthodontic Problems.'' A number of clinics and case reports were also given. Twelve new members were taken in at this meeting.

A special meeting of the Southern Society was held at the Biltmore Hotel, Atlanta, Ga., April 14, 1925, at which time several new members were taken in. At this time a committee was appointed to revise the constitution and bylaws.

The next meeting was held in Louisville, Ky., in 1926 and Dr. Joseph E. Johnson was then president. Dr. Joseph E. Johnson presided, Dr. H. C. Hopkins having previously sent in his resignation due to illness in the family. About fifteen new members were taken in at this meeting. Several papers, clinics, and case reports were given. One was by Dr. E. L. Mitchell, of Indianapolis, who read a paper entitled ''Ribbon-Arch of Orthodontia.'' A paper was given, ''Relation of Occlusion to the Supporting Tissues,'' by Dr. John T. O'Rourke, of Louisville. At the business session Tuesday afternoon, March 30, report of the Committee on Constitution and Bylaws was brought up and unanimously adopted. During the afternoon session on Tuesday a paper was given by Dr. C. C. Howard, ''A Preliminary Report of Infra-Occlusion of the Molars and Pre-Molars. Produced by Orthopedic Treatment of Scoliosis.'' Due to the illness of Dr. Lloyd S. Lourie, of Chicago, Dr. James Ford, of Chicago, read a paper on ''The Use of High Labial Arch.'' The next paper, ''Simon's Method of Diagnosis,'' was presented by Dr. C. A. Hawley, of Washington, D. C. A number of clinics were presented as well as case reports.

The sixth annual meeting was held in Asheville, N. C., at which time Dr. Harry Holder was president. At this meeting we had a balance of $534.30. A number of new members were voted in. A paper was given by Dr. Clarence O. Simpson, of St. Louis, entitled ''Advantages of Radiographic Examination in Orthodontics.'' In the afternoon a paper was given by Dr. Harry Kelsey, of Baltimore, ''The Value of Early Scientifically Corrective Diagnosis of Malocclusion as Compared With Experimental Diagnosis.'' A paper on ''Mouth Breathing'' was given by Dr. H. H. Briggs, of Asheville, N. C. A number of clinics and case reports were also held. On Wednesday afternoon a paper was given by Dr. Martin Dewey, of New York City, on ''Standardization of Appliances and Treatment of Uni-Lateral Bi-Lateral Posterior Occlusion.'' A paper was also given by Dr. C. C. Howard on ''The Original Method of Constructing Extra-Oral Anchorage.''

The seventh annual meeting was held in Baltimore, Md., and Dr. Harry E. Kelsey was president. At this time we had a balance in the treasury of $586. A paper was given by E. V. McCullom, ''Calcium and Its Relation to Bone Development.'' At this meeting a resolution regarding joint meeting of the Southern Society and the Southwestern Society was passed, and read as follows: ''Whereas the Southern Society of Orthodontists and the Southwestern Society of Orthodontists are organized for the same purpose, that it is for

the advancement of orthodontia as a science in promoting better friendship among professions, therefore be it resolved that in 1930 or some date thereafter the Southern Society and the Southwestern Society of Orthodontists hold a joint meeting every five years for the better interest and further promotion of orthodontia." This resolution was passed. A number of case reports and clinics were given at this meeting.

The eighth annual meeting of the Southern Society was held in Macon, Ga., and Dr. W. B. Childs was the president. A paper was given by Dr. O. A. Oliver on "Technic on the Lingual Arch Construction." A paper, "The Relation of the Orbital plane to the Detention of Different Races," was given by Dr. Milo Hellman, of New York City. A paper was given on the "History of Education" by Dr. W. F. Quillan, President of Wesleyan Female College. An address was given by Dr. H. H. Johnson, of Macon, Ga., "Influence of Specialization on Dentistry." An address also was given by Dr. A. H. Ketcham, President of the American Society. This was the first time that a president of the American Society of Orthodontists had visited a Southern Society meeting. A paper was also given by Lloyd S. Lourie, of Chicago, "Trimming Deciduous Teeth to Favor Normal Eruption of Permanent Teeth or to Assist in Correcting Malocclusion." A paper was also given by Dr. T. Wingate Todd, of Cleveland, Ohio. A number of case reports and clinics were given and a number of new members were taken in.

The ninth annual meeting was held at the Noel Hotel, Nashville, Tenn., April 7, 1930. Dr. C. A. Hawley, President, passed away during the year and Dr. Carl Mott, President-Elect, presided at this meeting. A number of new members were taken in. The following men were recommended for honorary membership: Dr. Albert H. Ketcham, Dr. T. Wingate Todd, Dr. Milo Hellman, and Dr. Holmes Mason. These men were elected as honorary members of the Society. Since the American Society of Orthodontists meeting was to be held in Nashville this year we had only a business meeting and turned our effort toward making the American Society meeting a big success.

A called meeting of the Southern Society was held at the Noel Hotel, Nashville, Tenn., April 11, 1930. Elected to represent the Southern Society of Orthodontists at the Second International Orthodontic Congress were Dr. Harry E. Kesley, Dr. Oren A. Oliver, and Dr. C. C. Howard.

The tenth annual meeting of the Society was held in Miami, Fla., 1931, Dr. Carlton B. Mott, President of the Society, presiding. A paper was given by Dr. A. LeRoy Johnson, New York City, "The Growth as a Factor in Prognosis." A paper was also given by Dr. Herbert E. Pullen entitled "Some Studies of the Molar and Pre-Molar Teeth in Relation to Anchor Band Construction and the Health of Dental Tissue." A paper was given by Dr. Alfred P. Rogers, of Boston, Mass., "Diagnosis and Treatment of Class III." Balance on hand was \$738.82. A number of papers, clinics, and case reports were given, and several new members were taken in at this meeting.

The eleventh annual meeting was held in Cincinnati, Ohio. Dr. W. J. Fitzpatrick was president. Balance on hand was \$383.30. In the afternoon

session the meeting was devoted to a joint session of the Ohio State Dental Association and the Southern Society of Orthodontists. Dr. Martin Dewey, of New York City, President of the American Society of Orthodontists, and an honorary member of the Southern Society, gave an address. A paper was given by Dr. F. Blane Rhobotham, Chicago, Ill., entitled "Studies in Children's Dentistry." A paper was given by Dr. C. F. Bodecker, of Columbia University, the title, "Dental Decay Environmental or Constitutional." A paper was given by Dr. Frank M. Casto, "Problems Related to Orthodontic Treatment." A paper was given by Dr. Earl G. Jones, "Orthodontic Education." A number of case reports and clinics were given and quite a few men were taken in at this meeting.

The twelfth annual meeting of the Southern Society of Orthodontists was held in Knoxville, Tenn., Dr. Claude R. Wood, President. A paper was given by Dr. Hugh K. Hatfield, of Boston, Mass., entitled "A Review of Brash on Conditions of Growth." A paper was given by Dr. A. LeRoy Johnson, of New York City, "Preliminary Study of Skulls and Teeth of Dogs." A paper was given by Dr. B. Holly Broadbent, of Cleveland, on the "Roentgenographic Measurements of the Developmental and Orthodontic Changes in the Faces of Growing Children." A paper was given by Dr. Milo Hellman, of New York, on "Growth of the Face and Occlusion of the Teeth in Relation to Orthodontic Treatment." A number of case reports and clinics were given and several new members were taken in. A total membership of 43 members were present, 20 guests paying, 29 guests nonpaying, 3 exhibitors, and 15 orthodontists, officers of the American Society and essayists and clinicians, a total of 110.

The thirteenth annual meeting of the Society was held at Hot Springs, Va., and Dr. N. F. Muir was president. At this time we had 53 members and had a balance of $880.57. A paper was given by Dr. J. A. Detlefsen, of Swarthmore, Pa., entitled "Quantitative Evaluation of Etiological Factors in Orthodontia." A number of case reports and clinics were given at this meeting. A paper entitled "Congenital Syphilis and Malocclusion" was given by Dr. Frederick R. Stathers of Philadelphia. A lecture on the "Standards of Orthodontic Materials" was given by Dr. Wilmer Souder, of Washington, D. C. A paper, "The Conduct of Orthodontic Practice," was given by Charlie Baker, of Evanston, Ill. A paper, "Orthodontics, Whither Heading?" was given by Dr. Leuman M. Waugh. A number of case reports and clinics were given and several new members were taken in.

The fourteenth annual meeting was held in Chattanooga, Tenn., Dr. Winston P. Caine presiding at the meeting as president. Balance on hand was $1,118.44. A paper was given by Dr. Ernest N. Bach, of Toledo, entitled "Graphic Illustration of Appliance Construction." A paper was given by Dr. Harvey G. Bean, Toronto, Canada, "A Functional Appliance." A number of case reports and clinics were given and several new members were taken in. A motion picture on "Band Technic, Construction of Labial and Lingual

Arches, Auxiliary Springs and Guide Plane'' was given by Dr. Oren A. Oliver. During the afternoon session a paper, ''Facts, Fictions and Fallacies in Orthodontia,'' was given by Dr. Andrew F. Jackson, of Philadelphia.

The fifteenth annual meeting was held in Atlanta, Ga., and Dr. William A. Clarke was president. There was a balance of $1,415.51 in the treasury. A paper was given by Dr. James K. Fancher, Medical Director of the Good Samaritan Endocrine Clinic of Atlanta, Ga., entitled ''Endocrine Factors in Growth and Development.'' A paper was given by Dr. H. C. Pollock, of St. Louis, ''Extending the Boundary Lines of Orthodontic Service.'' At this meeting a committee was appointed to investigate the material offered for excavation of the Indian mound both in St. Simons and in Macon, Ga. The Committee was Sam G. Cole, W. J. Clarke, and Harle Parks. A paper was given by Dr. Glenville Giddings, Assistant Professor of Medicine, Emory University, entitled ''Child Growth and Development.'' A paper was given by Mary Stuart MacDougall, Ph.D., Professor of Biology, Agnes Scott College, ''The Physical Basis of Heredity.'' A number of clinics and case reports were given and also new members were taken in.

The sixteenth annual meeting was held in Spartanburg, S. C.; Dr. Clyde O. Wells was president. The balance in the treasury was $1,612.45. Several new members were taken in at this meeting, a number of case reports and clinics were given, and a number of papers were also given. A paper by Dr. D. Lesesne Smith, Spartanburg pediatrician, entitled ''Growth and Development'' was given. In a report of the committee of D. T. Carr, W. B. Childs, and E. W. Patton they stated, ''We regret that the committee on Investigation of Excavations in Georgia found the Indians too dead to be of material orthodontic value at this time.'' A paper on ''The Control of Habits in the Treatment of Malocclusion'' was read by Dr. Leland R. Johnson, of Chicago. A paper was given by Dr. John A. McPhail, ''Practical Suggestions for Building a Competence.''

The seventeenth annual meeting of the Southern Society was held in Savannah, Ga., and Dr. Sam G. Cole was the president. The balance in the treasury was $1,584.72, a savings account of $1000 making a total of $2,584.72. A number of new men were taken in at this meeting. Dr. M. S. Aisenberg, of Baltimore, presented a paper, ''Studies of Retained Deciduous Teeth and Roots.'' Dr. Antonio J. Waring, pediatrist, of Savannah, Ga., gave a paper, ''Some Interesting Data in the Pediatric Field.'' A number of case reports and clinics were given. Dr. LeRoy Johnson was introduced and gave a most interesting presentation entitled ''The Relation of Genetic Constitution to Structural Form, Endocrine Function and the Effect of Diet.''

The eighteenth annual meeting was held in New Orleans and Dr. A. C. Broussard was president. The balance in the treasury was $2,776.98. Several new men were taken in at this meeting and a number of case reports and clinics were given. Dr. William A. Murray, President of the American Association of Orthodontists, gave a very interesting talk at this meeting. Dr. Rowlett who represented England at the Dental Centenary Celebration was present and gave a very brief talk. Dr. Stanley Crouch, of Toronto, Canada,

was also present and made a few remarks. Dr. Archie B. Brusse, of Denver, Colo., gave an illustrated lecture on spot-welding using the twin arch wire and the Fitzgerald x-ray technique. Oscar V. Batson, M.D., Philadelphia, gave an interesting lecture on muscle form and function and the influence muscles have on bone transformation. Dr. Spencer R. Atkinson, of Pasadena, Calif., gave a lecture, "The Changing Internal Anatomy of Developing Faces." At this meeting the Code of Ethics of the American Dental Association and the American Association of Orthodontists was adopted as the Code of Ethics for the Southern Society of Orthodontists.

The nineteenth annual meeting of the Southern Society of Orthodontists was held in 1941 at Sir Walter Hotel, Raleigh, N. C. Dr. G. Fred Hale was president. The total balance was $3,063.83. Dr. O. A. Oliver was introduced as president of the American Dental Association and Dr. Claude R. Wood was introduced as president of the American Society of Orthodontists. Dr. Philip E. Adams gave a paper on "Consideration of Etiology." Dr. Joseph E. Johnson gave a paper on "The Treatment of Different Types of Malocclusion With the Twin Arch Mechanism." Several new members were taken in at this meeting. A number of case reports and clinics were given.

The twentieth annual meeting of the Southern Society of Orthodontists was held in New Orleans March 16, 1942, Dr. William P. Wood, President. Dr. O. A. Oliver, President of the American Dental Association, was present at the luncheon. Brigadier General Leigh C. Fairbank gave some interesting information in regard to the Army Dental Corps. The "Sage of Atlanta," the first president of the Society, Dr. C. C. Howard, was called on to present past-presidents' keys to all of those who had served the Society in that capacity. Several new members were taken in at this meeting. There was a balance on hand of $2,942.24.

The twenty-first annual meeting of the Society was held at the Piedmont Hotel, Atlanta, Ga., Oct. 23, 1944, Dr. M. Bagley Walker, President. A number of new men were taken in at this meeting. At this meeting Dr. C. C. Howard, of Atlanta, Ga., was made an honorary life member. Dr. Russell E. Irish, of Pittsburgh, Pa., was unanimously elected to honorary membership in recognition of his untiring efforts in the progress of orthodontics. A balance of $4,319.65 was in the treasury. A number of case reports and clinics were given. Dr. Byron O. Hughes, Ann Arbor, Mich., gave a paper, "Possible Applications of Recent Findings in Heredity and Growth in the Practice of Orthodontics." A panel discussion was held by Dr. Joseph E. Johnson, Louisville, Ky., "The Philosophy of the Twin Arch Appliance," Dr. Oren A. Oliver, Nashville, Tenn., "Philosophy of the Labio-Lingual Technic," Dr. Allan G. Brodie, Chicago, Ill., "Philosophy of the Edge-Wise Arch Mechanism." A number of case reports and clinics were given at this meeting.

In 1945 Dr. A. S. Bumgardner was president but no meeting was held that year. Dr. Bumgardner remained president and his meeting was held in Charlotte, N. C., in January, 1946. Dr. Hays N. Nance, of Pasadena, Calif., was one of the featured essayists. His paper was entitled "Some Clinical

Facts Which Definitely Influence Orthodontic Diagnosis and Prognosis." He also gave quite an elaborate table clinic. The other featured essayist at this meeting was Dr. Harold E. Kesling, LaPorte, Ind. His paper was entitled "Co-ordinating the Pre-Determined Pattern and Tooth Positioner With Conventional Treatment." He also gave a table clinic. Dr. Russell E. Irish was also featured on this program and the title of his paper was "A Discussion of Treatment Based Primarily on Labio-lingual Therapy." At this meeting a resolution was adopted regarding the American College of Dentists Committee on Journalism which had created and executed a plan for propaganda purposes and sent reprints throughout the United States to the American Dental Association which contained false and misleading statements in regard to the public relations of the AMERICAN JOURNAL OF ORTHODONTICS AND ORAL SURGERY and the American Association of Orthodontists and its component societies. There is no audit report of the minutes at the completion of the 1946 meeting.

There is an audit of the 1947 meeting which includes from December, 1944, to April 8, 1947. According to this report the bank balance of December, 1944, was $2,374.01, and the balance for April 8, 1947, was $4,007.82.

The twenty-third annual meeting or the 1947 meeting was held in Mobile, Ala., Dr. Jim E. Brown, President. The featured essayists of this program were Dr. George Moore, Dr. Harry Sicher, and Dr. A. P. Westfall. One of the best high lights of this meeting was the Society's going on record to bring West Virginia back into the Southern Society. The bank balance as mentioned April 8, 1947, was $4,007.82. However, this is the total before the expenses of the 1947 meeting were paid.

The twenty-fourth annual meeting or the 1948 meeting was held October, 1948, in Memphis, Tenn. Dr. Neil J. Leonard was president. The featured essayists were Dr. Harry Neivert, the rhinologist, who was supposed to be one of the best in the country. The title of his paper was "Rhinologic Experiences Aid the Orthodontist." Dr. Leigh Fairbank was also on the program, giving a paper entitled "Orthodontics as a Prescribed Therapy." Also at this meeting Dr. Lowrie Porter, President of the American Association of Orthodontists at that time, presented a discussion of Dr. Fairbank's paper, supplementing his discussion with additional slides. At this meeting Dr. Frank P. Bowyer presented his Public Relations Report which created quite a bit of interest, discussion, and comment. The bank balance Oct. 4, 1948, was $4,090.06. This balance was prior to the payment of the meeting expenses. Incidentally, Leland Daniel was secretary during the years just mentioned. Dr. Bowyer was elected Secretary at this meeting. After all the bills were paid the amount of money in the treasury when Dr. Bowyer took over from Dr. Daniel was exactly $3,000, in addition to the two $500 government bonds, giving a total asset of $4,000.

The next meeting was held in New Orleans, October, 1949. Sam Gore was president. This was the twenty-fifth annual meeting. Our featured essayists were Dr. W. M. Krogman who spoke on "Dynamic Growth or Static Tech-

nique''; Dr. Arthur C. Totten gave a paper on ''Whither We''; and the other essayist was Dr. Brooks Bell who discussed office routine. The bank balance prior to this meeting was $4,354.19.

The twenty-sixth annual meeting was held in Miami Beach with Dr. E. C. Lunsford as president. The principal essayists at this meeting were George Crozat and Sam Gore whose presentation was ''A Discussion of the Construction and Uses of the Precious Metal Removable Appliance.'' Also featured on this program was a return visit of Dr. Krogman. On this program also was Bill Oliver who presented ''Construction and Placement of the Mesio-Incisal Guide Plane,'' and Hal Terry presented ''The Temporomandibular Joint in Guide Plane Cases.'' One of the high lights of this meeting was a trip to Cuba. The balance prior to this meeting was $5,295.72.

The twenty-seventh annual meeting or the 1951 meeting was held in White Sulphur Springs, William H. Lewis, President. Our featured essayists were George M. Anderson who spoke on ''Information for Parents Regarding Orthodontic Treatment,'' John R. Thompson who discussed ''Individual Norm Concept of Occlusion of the Teeth'' covering morphology and function. The other essayist was Joseph R. Jarbak who discussed the treatment of Class I and Class II malocclusion with bite plane and cervical strap. Also featured on this program, as you well remember, was Bernard deVries who discussed ''The Relationship Between the American Association of Orthodontists and Its Members.'' The bank balance just prior to the 1951 meeting was $6,756.91.

These are the high lights of the first twenty-seven meetings of the Southern Society of Orthodontists. The programs of 1924, 1925, 1926, 1929, 1930, 1933, 1935, 1936, 1942, 1943, and 1945 are needed. Should any of you have these programs, please send them to Dr. Frank Bowyer, Secretary-Treasurer, Knoxville, Tenn. I think it would be fine to be able to have all of the programs of the Southern Society of Orthodontists bound and preserved.

It is quite interesting to read through these programs and see the number of men who have made contributions to the Southern Society. It is also quite interesting to see the number of men of our own Society who have given clinics and papers as well. It is also interesting to note the great contributions that have been made by various members of the Southern Society of Orthodontists to the American Association of Orthodontists and other sectional societies. It becomes a challenge of you younger men to carry on and I am sure that you will.

1915 BROADWAY.

A STUDY OF CHANGES IN TEMPOROMANDIBULAR RELATIONS ASSOCIATED WITH THE TREATMENT OF CLASS II MALOCCLUSION (ANGLE)*

ROBERT MURRAY RICKETTS, D.D.S., M.S.,** PACIFIC PALISADES, CALIF.

IN 1942 Thompson and Brodie published the results of their investigations on "Factors in the Position of the Mandible." Their findings, derived from the serial cephalometric x-ray study of an adequate sample, led them to postulate that "the position of the mandible in relation to the rest of the face and head is an integral part of the pattern of the individual and is just as unchangeable as its form." Subsequent studies by Thompson (1946) showed unmistakably that the mandible could be, and often was, deflected from a normal upward and forward path of closure as it traveled from its physiological rest position to full occlusion. Such deflections were at first thought to be due to tooth interference but a similar behavior in cases in which tooth interference could not be demonstrated led to a search for other factors.

To obtain an x-ray image of the mandibular condyle by cephalometric x-ray, it is necessary to make the exposure while the patient holds the mouth wide open so that the condyle is brought forward and downward on the articular eminence. Due to the superimposition of the denser petrous element of the temporal bone, it is not possible to delineate the glenoid fossa. In the studies referred to previously herein the outline of the complete mandible was traced from the film taken at wide mouth opening and the head of the condyle was transferred to the tracings of the rest and closed positions. Thus the changes in the various functional positions of the condyle could be studied and its directions of movement traced. Such studies indicated that the typical path of mandibular closure from rest to occlusion was an upward and forward rotation. However, other cases revealed that the condyle might move in a nonrotary direction. Such cases came to be classified as "thrust" and it was believed that they resulted in a jamming of the condyle upward and backward in the fossa. This belief was based on the assumption that when the mandible was at rest position, the condyle was in the typical relation to the fossa that has been portrayed in the textbooks. However, studies by Blume (1947) and by Boman (1948) conducted with the Lindblom head positioner revealed that the resting position did not invariably find the condyle in the typical upward and forward relation to the fossa.

---

*This thesis was chosen as the prize essay in the 1952 prize essay contest of the American Association of Orthodontists.—*ED.*

**University of Illinois College of Dentistry, and Department of Radiology, School of Medicine.

Review of the literature on the temporomandibular joint failed to reveal any study that had been directed at a determination of the range of variation that might exist in normal joints and it was thought that such a study would be prerequisite to an understanding of the abnormal. It was therefore undertaken on a sample which consisted of the 100 joints of 50 individuals, none of whom had any clinical manifestation of joint disturbance.

The method of choice was cephalometric laminagraphy because that technique permits: (1) the elimination of distortion that might be introduced by angular exposures; (2) makes possible the exposure of a field sufficiently large to include orientation landmarks and functionally associated structures, such as the teeth; (3) permits the selection of the midsagittal relation of condyle and fossa. (Fig. 1.) By preparing a plaster core with the patient in an upright position it is possible to take the exposure of the physiological rest position.

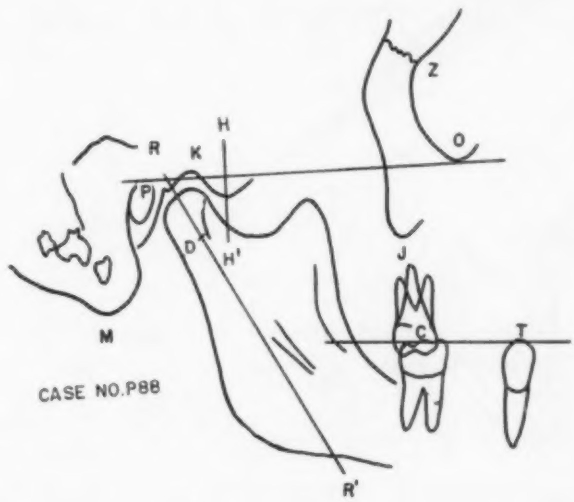


Fig. 1.—A typical temporomandibular joint laminagram tracing. The structures in focus in the body-section will be noted, together with the points, planes, and angles used in the study: *M*, mastoid process; *P*, porion; *K*, point on the most superior curvature of the roof of the fossa; *O*, orbital; *Z*, zygomatico frontal suture; *J*, jugal process of the maxilla (key ridge); *C*, centrobuccal cusp of the lower first molar; *T*, tip of the cuspid; *D*, point at center of the neck of the condyle selected by completing the arc of a circle circumscribed by the condyle head; *PO*, Frankfort plane; *CT*, occlusal plane of the lower denture; *R R′*, line bisecting the neck of the condyle and extended through the ramus; *H H′*, perpendicular through *PO* at summit of the eminentia articularis.

As a second part of this study, the right and left joints of fifty individuals with unmistakable Class II malocclusion were examined by laminagraphy. It was not possible to duplicate the age range of the first sample, the mean age for this group being 14 years as against 21.5 years for the first.

Unexpectedly wide ranges were found in all morphologic characteristics in the control group except in the dimension between condyle and articular eminence. Here a difference of only 2.5 mm. was shown between the high and low extremes. Essentially the same morphologic variation of individual parts was found in both the control and the Class II samples. However, certain other relationships revealed significant differences between the two samples.

The most startling difference between the two groups was the position of the mandible at rest. Whereas the control group exhibited the accepted condyle-fossa relation with a mean interocclusal dimension of 1.8 S.D. 0.9 mm. at the molars, the Class II sample revealed the condyle downward and forward in the fossa and with a mean interocclusal dimension of 3.6 S.D. 1.6 mm., i.e., double that of the control. (Fig. 2.)

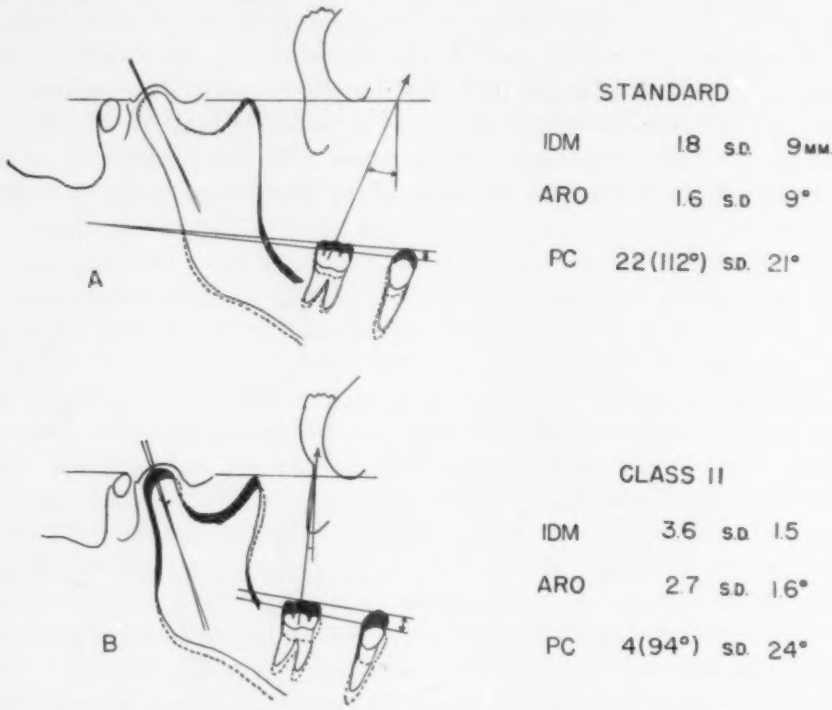


Fig. 2.—Illustrates differences between the control group of 100 cases (standard) and 100 Class II malocclusion cases in the movement from rest to closure. Means and standard deviations of certain denture relationships are presented: *IDM*, interocclusal dimension at the first molar (freeway space); *ARO*, angle of rotation of the occlusal plane; *PC*, direction of path of closure from a perpendicular to Frankfort plane. *A*, Findings on the control. Note rotation of the condyle around "point *D*" (see Fig. 1); *B*, findings on Class II. Note an average 2 mm. translation of condyle head. Note the mean *IDM* twice that of the control, wider rotation in the Class II, and almost vertical path of closure in the Class II. Note also wider variation in Class II as indicated by greater values of standard deviation.

When the direction of the path of closure was studied, a range of variation of 86 degrees was found in the control and one of 104 degrees in the Class II group (Fig. 3). However, the distribution of the range was significantly different. The range of the control extended from 60 degrees forward of a perpendicular to Frankfort plane to 26 degrees in back of the same perpendicular. The range of the Class II group extended from 49 degrees forward of the perpendicular to 55 degrees behind. This resulted in a mean of 22 degrees forward for the controls and 4 degrees forward for the Class II group (Figs. 2 and 3).

These combined findings indicated, to me at least, that Class II malocclusion was frequently characterized by a forward and downward position of the mandible when that bone was at rest. Since the condyle-fossa relationship was

almost identical with that of the control group when the teeth were occluded, it followed that the mandible in Class II malocclusion must follow an upward and backward instead of the normal upward and forward course, and further that the movement was more translatory in nature. The present study was undertaken to determine the nature of any changes in the joint that might take place in those Class II malocclusions that received orthodontic treatment.

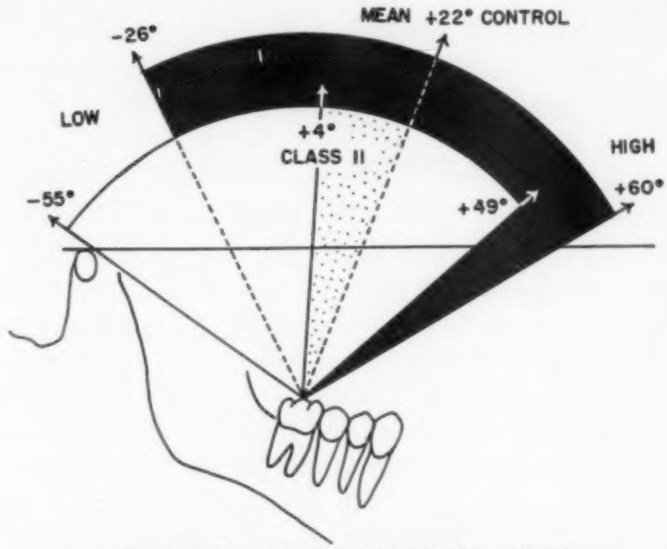


Fig. 3.—Represents differences in the mean and differences in the range of variation of the control and Class II groups. Note that the means and extremes of the Class II fall about 15 degrees more posterior than in the control.

METHOD AND MATERIAL

The combined methods of cephalometric roentgenography (Broadbent, 1931) and cephalometric laminagraphy (Brader, 1949) were employed for the present investigation. Radiographic recordings were obtained on fifty individuals at the start and at the completion of orthodontic correction of Class II malocclusion. The group consisted of eighteen male and thirty-two female patients, average age, 12 years. The girls averaged 11.6 years and the boys averaged 12.5 years of age. The follow-up x-rays were taken as nearly as possible at the time of placement of retention. The average length of treatment was twenty-five months. The shortest records were obtained in ten months and the longest interval was forty-two months. The original records of 74 per cent of the patients had been a part of the previous study of Class II variation. All but four of the patients were treated with intermaxillary elastics. The balance were treated with cervical anchorage and bite plate.

A control group of eleven female and six male patients of comparable age was studied over an average time of twenty-six months. These patients were

normal or Class II cases who received no orthodontic treatment, or were Class I cases treated without the use of Class II intermaxillary elastics.

Tracings were made of the usual structures observed in the headplate. In addition, the tip of the basilar portion of the occipital bone was traced in order to locate point basion (anterior border of foramen magnum). A line was drawn from basion to nasion and was used for purposes of comparing the before and after treatment tracings. Other planes employed on the headplate were the Y axis, Frankfort plane, facial plane, occlusal plane, and mandibular plane. (Fig. 4.)

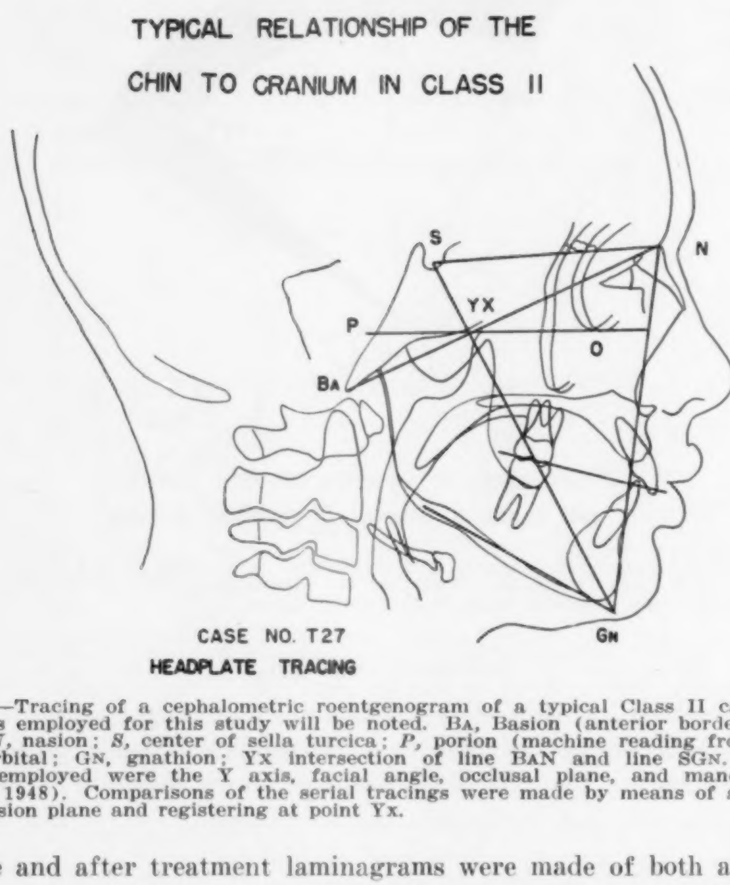


Fig. 4.—Tracing of a cephalometric roentgenogram of a typical Class II case. The following points employed for this study will be noted. BA, Basion (anterior border of foramen magnum); *N*, nasion; *S*, center of sella turcica; *P*, porion (machine reading from cephalometer); *O*, orbital; GN, gnathion; YX intersection of line BAN and line SGN. The planes and angles employed were the Y axis, facial angle, occlusal plane, and mandibular plane (see Downs, 1948). Comparisons of the serial tracings were made by means of superimposing on basion-nasion plane and registering at point YX.

Before and after treatment laminagrams were made of both articulations with the patient at full occlusion of the teeth as well as at physiologic rest. For the follow-up records, the patients were repositioned in the laminagraph head-holding apparatus according to their initial registrations. All laminagraphy was executed by me. The films were traced to include craniofacial and joint structures, the mandible and the buccal segment of teeth, following the same method as that of the original investigation. Pertinent points to be investigated were condylar growth and position in the occluded and rest positions of the mandible, and condyle movement. Denture relationships included the cant of the occlusal plane, interocclusal dimension, and the direction of the path of closure at the lower first permanent molar.

FINDINGS

A. *Changes in Joint Function.*—

1. *Condyle position in occlusion:* For this evaluation, a measurement of the distance from the top of the condyle to the roof of the fossa proved adequate for purposes of comparison, and was called the supracondylar dimension. It will be remembered that the first study revealed that the position of the condyle in the fossa had been found to be essentially the same in the control and Class II samples when the teeth were in full occlusion. It was therefore not surprising to find that 86 per cent of the cases studied after treatment showed repositioning only up to 1 mm. downward and forward or upward and backward of the original position. The greatest change noted was 2.5 mm. downward and forward in one case. The mean of this relation was 2.5 mm. S.D. 0.77 mm. before treatment and 2.2 mm. S.D. 0.8 mm. following treatment.

2. *Condyle position at rest:* The supracondylar dimension indicated characteristic downward and forward rest position of the condyle in two-thirds of the Class II group. After treatment, the distance from the condyle to the fossa roof diminished to almost exactly that of the control (mean of control, 2.73 S.D. 1.05 mm., mean of Class II, 2.7 S.D. 1.02 mm.). Only five condyles were found to be more forward at rest following treatment, this distance ranging from 1.5 to 3 mm. The control (untreated cases) showed no measurable change in this relation.

3. *Condyle movement from rest to closure:* The first study had shown that cases classified as normal exhibited a predominant tendency to rotate about a point located slightly below the head of the condyle as the mandible moved from rest to closure (Fig. 2). Following treatment of the Class II cases, the movement of the condyle during closure from rest position was found to be markedly reduced. Whereas one-third of the pretreatment records indicated movement greater than 2 mm., only 4 per cent persisted in this range after treatment. Thirty-two per cent showed no translation prior to treatment, but 61 per cent could be so classified at the time retention was placed. All but nine of the joints studied showed less movement at the end of treatment. The untreated cases showed no alteration from the original position and function of the condyle.

B. *Denture Changes.*—

1. *Interocclusal dimension or freeway space:* This measurement taken between the rest and occluded position of the lower first permanent molar had yielded a mean value of 1.8 S.D. 0.9 mm. in the original control group. In the Class II sample before treatment it had been found to be almost twice as great, viz., 3.6 S.D. 1.5 mm. The interocclusal dimension of the treated Class II cases displayed a strong tendency to return to the standard value, the mean being 2.1 S.D. 1.1. The range from 0.5 to 6 mm. was only slightly wider than that of the control. In only one case was the interocclusal dimension more than 4 mm. The untreated sample showed strong tendency to remain unchanged.

The direction of the path of closure at the molar is measured in degrees from a perpendicular to Frankfort plane (Fig. 2). Forward movement is represented by a plus figure and backward movement by a minus. In the control group, the mean angle was +22 degrees while that of the Class II group before treatment was +4 degrees. Following treatment a mean of +14 degrees was found, indicating a return toward normal. However, the range was wider than before, with a high of +59 degrees and a low of –47 degrees, as against pretreatment figures of +49 degrees and –55 degrees. The untreated cases showed essentially no changes in the path of closure.

2. *Occlusal plane:* A line connecting the centrobuccal cusp of the lower first permanent molar and the tip of the cuspid was taken to represent the occlusal plane of the lower denture (Figs. 1 and 2). The Class II sample prior to treatment yielded a range of –9 degrees to +19 degrees in the cant of the occlusal plane to Frankfort plane. The mean was found to be +5.5 degrees and was 2 degrees lower than the standard. The treated sample revealed a mean of 11 degrees with a range of +1 degree to +23 degrees. Thus, the occlusal plane was tipped upward in the back or downward in the front about 6 degrees. The curve on the histogram showed symmetrical distribution about the mean. This behavior of the occlusal plane is a characteristic of Class II treatment when intermaxillary elastics are employed as shown by Brodie and associates (1938). Changes in the occlusal plane of the untreated cases were random in nature and slight in degree.

The next series of measurements were made in the attempt to discover by what means the mandibular condyle had attained a new rest position in the fossa as a result of, or coincidental to treatment. Two possibilities suggested themselves, viz.: (1) backward and upward growth of the condyle and (2) repositioning of the mandible. The first of these, i.e., growth, required investigation into the two matters of amount and direction.

A. *Amount of Condylar Growth.*—A line was drawn connecting two points of bisection of the width of the condyle neck and extended to intersect the lower border of the mandible on the first tracing (*RR′* line) (Fig. 1). Subsequent tracings were superimposed over the first and the *RR′* line was transferred. Increases along this line from the inferior border of the mandible to the top of the condyle were taken to represent the amount of growth of the condyle and ramus (Fig. 5).

The findings indicated that the amount of growth along *RR′* line varied from 0 to 12 mm. during treatment. The average increase per case was 4.5 mm. (Fig. 5) or an annual increase of 2.25 mm. However, differences were noted between the growth rates of the male and female patients, the former yielding 3 mm. per year and the latter 2 mm.

In the control (untreated) group the average increase per case was 4.1, or an annual increase of 2.05 mm. Again a slight but consistent sex difference was noted.

B. *Direction of Growth.*—The direction of growth was determined by superimposing the inferior border of the mandible and measuring an angular differ-

ence in the RR' lines before and after treatment (Fig. 5). When thus superimposed, growth directly in line with the long axis of the condylar neck was represented as 0, a more forward inclination of the condyle was denoted as plus, and a more posterior inclination as minus. The mean growth direction was almost exactly along RR' line, and 63 of the cases showed 1 degree or less change. Individual cases were observed to incline forward as much as 5 degrees or backward as much as 4 degrees. The distribution curve skewed slightly toward plus values, as 22 per cent were found in the range +2 degrees to +5 degrees and 15 per cent in the range −2 degrees to −4 degrees. The distribution of stability and change was practically identical in the untreated cases with those of the treated cases.

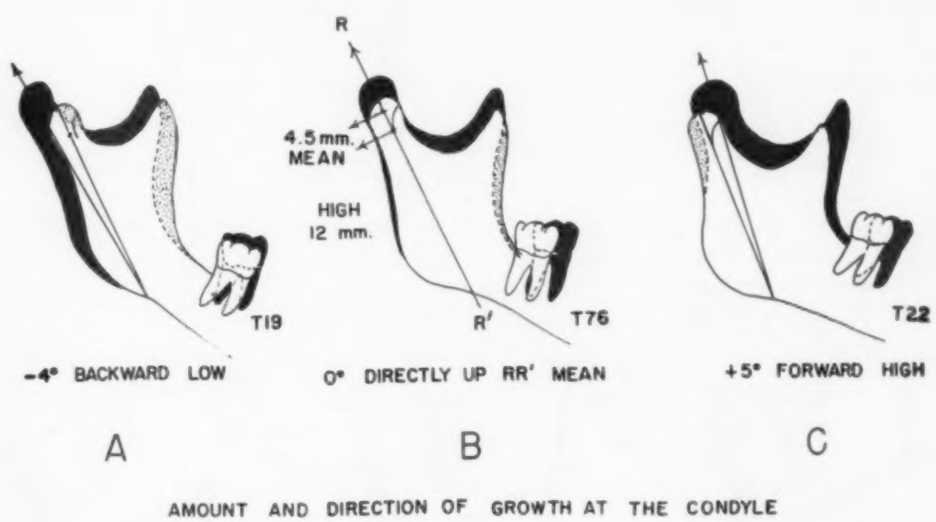


Fig. 5.—Illustrates variation of condylar growth behavior observed in Class II cases during treatment. The amount of growth is measured on R R' line. The average during treatment was 4.5 mm. The "high" was 12 mm. Direction of growth is indicated by superimposing the lower border of the mandible and measuring the angular changes in the R R' lines in the before and after treatment tracings. *A*, Upward and backward growth found in 15 per cent; *B*, growth directly up R R' line observed in 63 per cent; *C*, growth upward and forward exhibited in 22 per cent.

In order to investigate the possibility of changes in mandibular position as a result of orthodontic treatment, recourse was had to the cephalometric headplates of the same individuals previously studied by laminagraphy. The reason for this lay in the fact that while the laminagram yields an excellent image of the condyle-fossa relation, the ramus and buccal teeth, the field does not include the bony chin. The cephalometric x-ray, on the other hand, reveals the chin clearly but, as mentioned previously, the joint structures are obscured. Changes in mandibular position are read at the bony chin by relating that structure to various stable planes of the head. In the present study the problem was one of separating the effects of growth from those of changes in position.

It was quickly realized that it would not be possible to study this aspect of the problem by the same method as that employed for studying growth changes, i.e., by a comparison of the means of the treated and untreated samples. The results obtained from the longitudinal study of total changes in this and other

investigations (Björk, 1951, Downs, 1952, Lande, 1951, Brodie, 1951) revealed too wide a range of variation in the growth behavior of facial patterns to permit a lumping together of all of the cases in any one sample.

The comparison of the serial headplates of even a relatively small sample of individuals in the age range represented by the present study revealed that although the majority expressed their growth almost straight down the S-Gn line or Y axis of growth, others witnessed a closing of the Y axis in relation to cranial bases while still others exhibited an opening. In a similar way, some individuals appeared to be predominantly horizontal growers, i.e., they express their increases in a forward direction, while others follow a more downward course (Fig. 6). Again, the lower border of the mandible may depart from a constancy of parallelism in successive films, by dropping more in back and thus becoming more horizontal. These matters will become clearer as individual cases are considered.

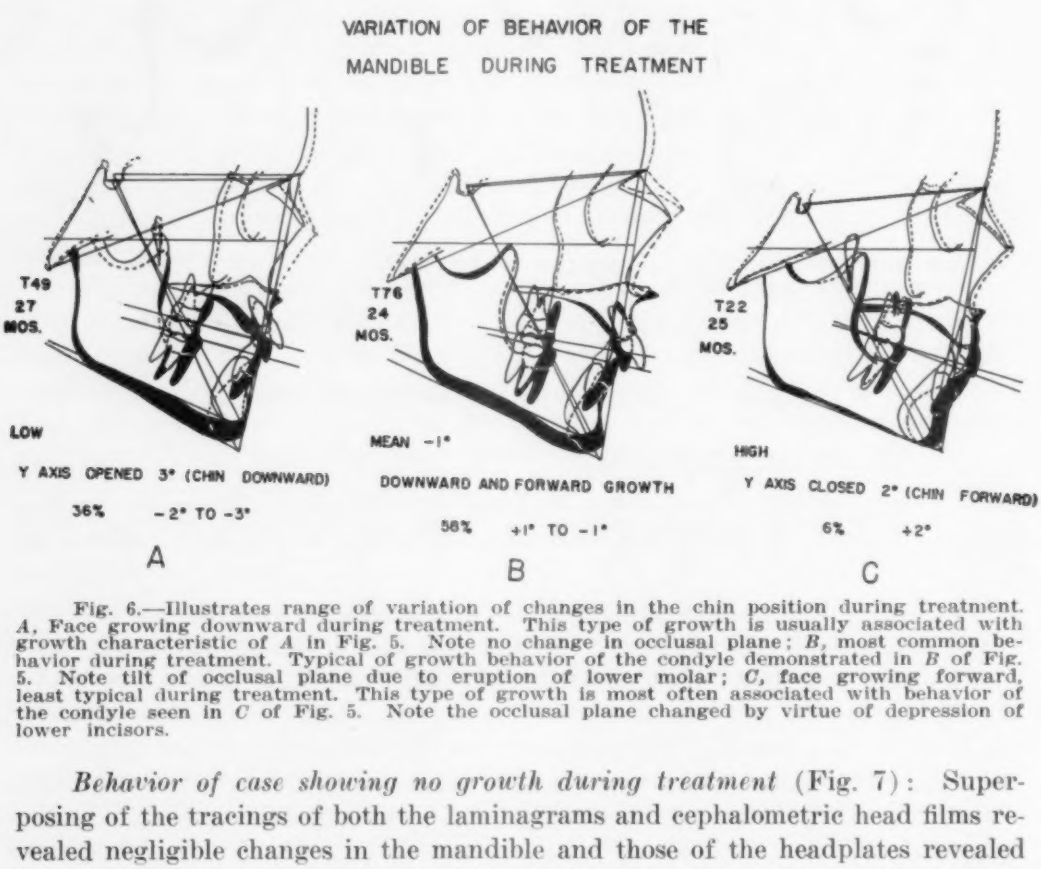


Fig. 6.—Illustrates range of variation of changes in the chin position during treatment. *A*, Face growing downward during treatment. This type of growth is usually associated with growth characteristic of *A* in Fig. 5. Note no change in occlusal plane; *B*, most common behavior during treatment. Typical of growth behavior of the condyle demonstrated in *B* of Fig. 5. Note tilt of occlusal plane due to eruption of lower molar; *C*, face growing forward, least typical during treatment. This type of growth is most often associated with behavior of the condyle seen in *C* of Fig. 5. Note the occlusal plane changed by virtue of depression of lower incisors.

Behavior of case showing no growth during treatment (Fig. 7): Superposing of the tracings of both the laminagrams and cephalometric head films revealed negligible changes in the mandible and those of the headplates revealed no changes in the cranial landmarks used in orientation. Superposing of the before and after treatment tracings with the teeth in occlusion showed a slight opening of the Y axis due, it was thought, to the tipping of the occlusal plane by the elastics, and a similar slight downward and backward rotation of the mandible due to the same cause. A comparison of the rest position tracings before and after treatment, however, showed them to be significantly different

—the tracing following treatment showed the mandibular condyle at a higher and more posterior position than it was prior to treatment. This was characteristic behavior for cases exhibiting downward and forward condyle position at the start and that showed little growth during treatment.

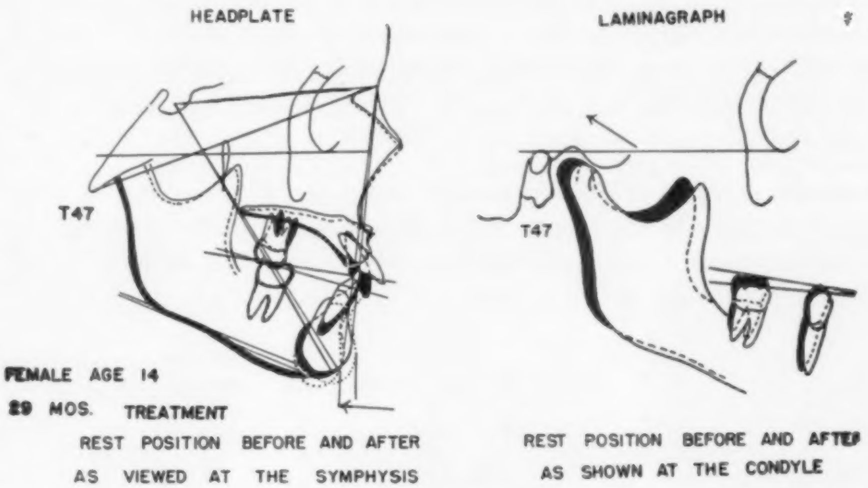


Fig. 7.—Illustrates a case of changed mandibular rest position during treatment. Note from the headplate relatively little growth of cranial structures and slight posterior positioning of the mandible in occlusion. Also note posterior position of the chin at rest at the close of treatment (dotted lines). Note from the laminagram a posterior positioning of the condyle with the mandible during treatment, typical of Class II, Division 1.

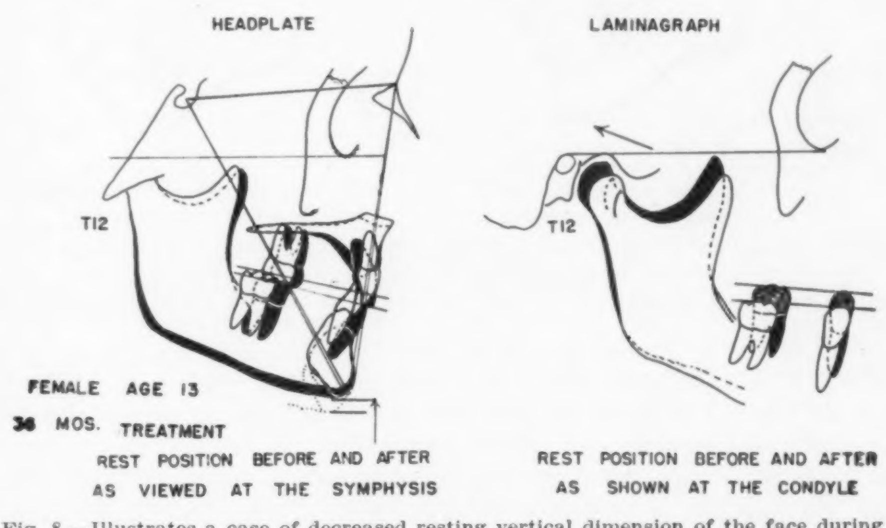


Fig. 8.—Illustrates a case of decreased resting vertical dimension of the face during treatment. Note in the headplate no evidence of growth of cranial structures, slight growth of the mandible almost along the Y axis, but a vertical height following treatment 3 mm. less than at the start. Note downward and forward condylar rest position before treatment changed to well-seated condylar position following treatment. Typical of Class II, Division 2.

Behavior of cases exhibiting horizontal growth: In these cases the tracings of the headplates taken before and after treatment with the teeth in occlusion disclosed unmistakable growth in a forward direction as indicated at the chin point. A comparison of the rest position before and after treatment, however,

revealed the mandible to be more posterior after treatment than before. The records of such cases are similar to those where no growth occurs except for degree.

Behavior of cases exhibiting vertical growth (Fig. 8): The findings in this group were similar to those in the previous group but the direction was different. The tracings of the films with teeth in occlusion showed an increase in height of the face during treatment but the rest position of the mandible following treatment revealed a *decrease* in facial height. In many instances growth went downward and the rest position did not.

Behavior of cases exhibiting growth along the Y axis (Fig. 9): A small number of the cases in the sample which had revealed no change in the condyle-fossa relation at rest during treatment nevertheless showed a better-than-average growth without change in the Y axis.

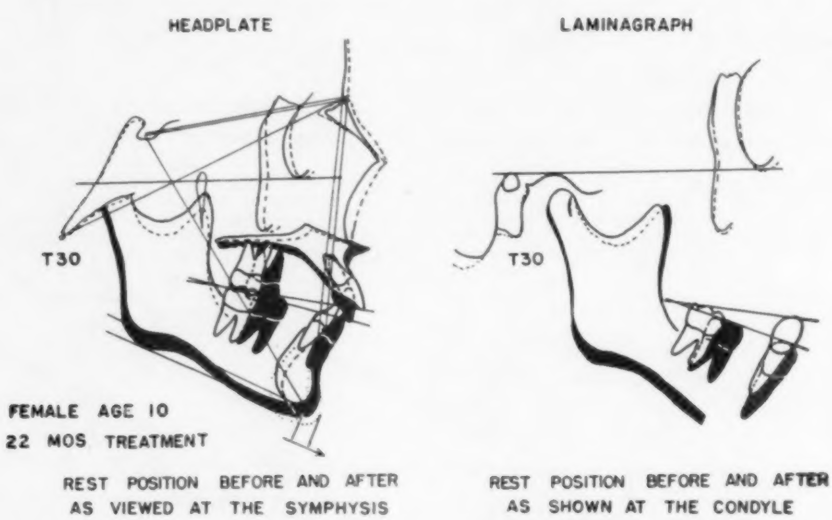


Fig. 9.—Illustrates a case of corrected Class II, Division 1 malocclusion but no change from a forward rest position in spite of growth. Note in the headplate the forward position of the chin at rest even after treatment, with upward and backward movement from rest to closure. Note from the laminagram adequate growth of the condyle but no change in its rest position.

Behavior of other miscellaneous Class II malocclusions: Certain of the Class II, Division 2 cases which had been shown to have forward rest positions prior to treatment were seen to follow the maxillary incisors as those teeth were carried labially during the first stage of treatment. They returned to their original rest position or beyond that to the normal condyle-fossa relation only as the maxillary denture was moved back.

A similar behavior was noted in certain Class II, Division 1 cases in which the maxillary first premolars had been extracted and the cases had been managed by moving the cuspid back and establishing buccal relationships prior to retraction of the upper anterior teeth. Starting with a forward resting position, the mandible had repositioned itself only as the anterior teeth of the maxilla had been carried back.

SUMMARY

A combined laminagraphic-cephalometric investigation on the results of treatment of fifty Class II malocclusions has been described. Attention was directed to changes that occurred in the relation of the mandibular condyle to the glenoid fossa during the period of management. A control group of 100 normal temporomandibular joints had been employed in a previous study to demonstrate the differences in joint relations between Class I and Class II occlusions. A sample of 17 normal, untreated Class II or treated Class I cases of the same age range was used as a control for the study of the effects of treatment. Observations covered a period of about twenty-five months for both groups.

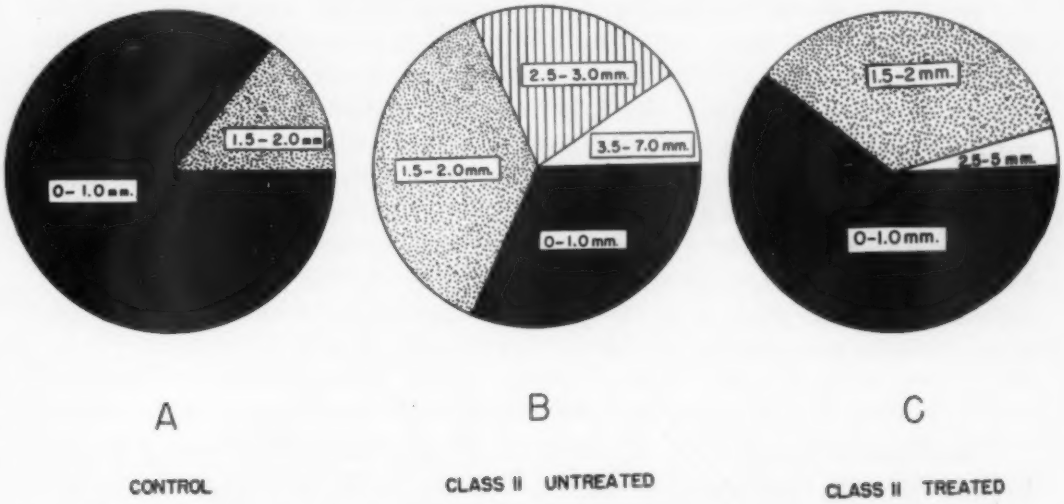


Fig. 10.—Amount of condyle movement. Pie diagrams representing movement of the condyle in the standard and the Class II cases before and after treatment. Note the marked decrease of movement in the treated Class II as these cases show strong tendency toward behavior characteristic of the normal. The plain section represents the two cases of no change in rest position such as is shown in Fig. 9.

Previous studies had shown that there were significant differences between normal and Class II condyle-fossa relationships. In the Class II cases there was a more forward and downward position of the condyles when the mandible was at physiologic rest, although little difference could be noted between the groups when the teeth were occluded. The Class II cases showed significantly greater interocclusal dimensions and the path of closure from rest to occlusion was significantly more posterior in direction and more translatory in nature.

Findings derived from records taken at the end of treatment revealed that all but two cases which showed a downward and forward condylar position before treatment exhibited a strong tendency toward an establishment of normal values. The condyle was seen to take a higher position in the fossa at its rest position, the interocclusal dimension approached normal values, and the path of closure tended toward a more upward and forward direction. These changes resulted in a decrease in the amount of movement of the condyle as it closed from the rest position. The findings are summarized in Fig. 10.

Since two possibilities existed to explain the changes that were seen at the end of treatment, viz., (1) backward and upward growth of the condyle and (2) positional shift of the mandible, the effort was made to study each separately.

Superposing the tracings of laminagrams of the ramus and condyle revealed that there was wide variation between cases in the magnitude of growth. This method also indicated that many cases exhibited changes in the direction of condylar growth, i.e., forward or backward. There were significant sex differences in the amount of growth, male patients being higher.

The first indication that the changes were due to repositioning was given by the control group which, although growing at the same rate, showed none of the changes in relation revealed by the sample of treated cases.

Further study of the behavior of the bony chin, derived from the cephalometric x-rays of the same individuals, revealed that the changes seen at that area could not be explained on the basis of growth. Those cases in which growth had been limited and predominantly forward or downward revealed resting positions back or above the pretreatment positions, respectively.

A few miscellaneous cases pointed strongly to the importance of incisal relations in the positioning of the mandible. In five Class II, Division 2 malocclusions the rest position of the mandible was observed to follow the upper incisors as those teeth were tipped labially in the initial period of treatment. As the mesiodistal relation of the jaws was corrected the mandible assumed a more posterior rest position similar to that seen in Class II treatment.

DISCUSSION

Studies of the position of the mandible, and especially of its resting position, have stressed the importance of that bone to the exclusion of other functions to the special activities of mastication and the maintenance of the posture of the head. Lacking a suitable method for the accurate determination of the condyle-fossa relationship at rest, it has been assumed that the condyle would be found in the usual position, i.e., upward and forward in the fossa both at rest and with the teeth in occlusion. The demonstrating of an upward and backward path of closure in a case has been taken to indicate a thrusting of the condyle deeper in the fossa.

The findings of the present study indicate that the majority of such cases are characterized by a resting position of the condyle that is downward and forward to its normal position and that the upward and backward path of closure witnesses a movement to the generally accepted position. Further, such a downward and forward resting position tends to remain constant in the untreated malocclusion. A large majority of treated cases, on the other hand, reveal condyles that are well seated in the usual position in the fossa when at physiologic rest. This poses the question as to which should be taken as the true resting position, that shown before treatment or that shown afterward.

It is a well-accepted orthopedic principle that all movable parts when at rest are maintained in positions that represent an equilibrium of forces. Such positions are constant and are characteristic of the individual and are considered normal if all skeletal relations are normal. It is equally well recognized that,

given abnormal skeletal relations, such as loss of an arm or congenital defects, the neuromuscular system makes compensatory adjustment to establish a new equilibrium. This equilibrium becomes stable for the new condition.

A Class II malocclusion represents a skeletal pattern that is characterized by an abnormal anteroposterior relation of the dental arches and jaws, the mandible being back or the maxilla forward of normal to the extent of one full cusp when the teeth are occluded. Such a malrelation introduces functional factors, other than those of mastication and posture maintenance, with which the mandible is concerned.

The inner aspect of the symphysis of the mandible is the area which supplies attachment for all of the muscles that hold the tongue forward as well as those which afford the anterior suspension of the hyoid bone, which in turn relates to the larynx and pharynx. Thus the mandible plays a vital role in the function of respiration, speech, and deglutition. Abnormality of any or all of these functions or of the other parts that serve them could conceivably call forth compensatory responses of the mandible in the interest of those functions. A few examples will serve to make this clear.

Several cases of the original control group (Class I) that had been studied to determine the range of variation in the mandibular rest position in the normal revealed condyle-fossa relations that were subsequently found to typify the Class II malocclusion. The cephalometric x-rays of these cases at the rest position revealed an edge-to-edge relation of the incisors, or even one where the lower incisors were anterior to the upper incisors. At first these cases were thought merely to represent extremes of the normal range until it was noted that they were also characterized by the presence of large masses of tonsillar and adenoid tissue. It was then realized that the forward position was made necessary by the demands of respiration and might therefore be a conditioned position. This finding gives a clue to an understanding of the behavior of the Class II malocclusion.

It will be recalled that the laminagrams had revealed that two-thirds of the Class II cases exhibited a downward and forward position of the condyle when the mandible was at resting position. The cephalometric x-rays of a large number of the same cases taken at rest were characterized by Class I molar relations. Furthermore, extreme Class II dysplasias of the facial pattern showed condyles almost at the summit of the articular eminence at rest with only a partial return of the condyle when the teeth were occluded. Had it been possible for the condyles to seat fully in the fossa in such cases, the mandibular arch would have been more than a full cusp distal to the Class II relation, a condition rarely seen in occluded models. In such extreme cases the function of speech was seen to be accompanied by noticeable forward and backward movements of the mandible.

The production of clear consonant sounds, e.g., the labials, linguals, and dentals, requires rather precise relation of the tongue, teeth, and lips. In a pattern with a retruded mandible, these relationships can be gained only by a forward movement of the mandible. It will be recalled that in five of the cases of Class II, Division 2 malocclusion studied, the mandible, although already for-

ward of the normal position at rest, went still further forward as the retruded upper incisors were moved labially in the initial stage of treatment. Their behavior during the second phase of treatment, which witnesses the change in mesiodistal relation of the arches, was identical to that of the Class II, Division 1 cases.

This evidence seems to indicate that the forward position of the condyle that was exhibited by two-thirds of the Class II sample is a conditioned position or accommodation in the interest of respiration and/or speech. In these cases there was a high degree of correlation between mandibular rest position and incisal relations. On the other hand, mention should be made of those Class II cases which exhibited normal condyle-fossa relations both at rest and closure. These made up the remaining third of the sample.

As in the majority group, these cases showed a wide range in the severity of the dysplasia. Lacking a more objective method, resort was had to direct observation of the mandible during speech activity. In the milder malocclusions nothing significant was noticed, but in the more sever dysplasias there was abnormally vigorous activity of the lips and tip of the tongue. In some, the deficiency seemed to be compensated almost entirely by the lower lip. In others, the upper lip seemed dominant, and in still others the tongue seemed to be attempting to carry the entire function unaided. Thus, even these findings seem to support the idea that some adjustment to the Class II malocclusion must be made in the interest of functions other than those of mastication and posture maintenance. The majority apparently make this adjustment by carrying the mandible slightly forward of its typical position, the others by hyperactivity of the lips and tongue.

But the findings also have implications for the rationale of Class II treatment, some of them quite opposite to oft-repeated assertion. For instance, it has often been stated that the wearing of Class II elastics leads to a forward movement of the mandible. In the light of the demonstration that the condyle is relatively more posterior at the end of treatment, this concept can hardly be sustained. True, there are cases in which the elastics seem to overcome the natural resistance in the joint with the result that a dual bite is established. Such cases, however, show little tendency for the condyle to assume its normal relation and they usually were found to relapse to the pretreatment state.

In a similar manner the findings would seem to explain the almost invariable failure of bite-jumping procedures. Such treatment has frequently been based on the assumption that if the mandible were held forward long enough there would be either (1) a compensatory change in the neck of the condyle, or (2) backward growth of the condyle into the fossa. Neither of these seems to occur. Even better evidence was supplied by the untreated cases which exhibited forward resting position of the mandible. In no case was the form or pretreatment position of the condyle seen to change.

The successful treatment of Class II malocclusion, as judged from the findings, would seem to depend upon the establishment of normal *incisal* relations, so far as condyle-fossa relations are concerned. In the growing child, this is accomplished simultaneously with the general correction of the mesiodistal

relations of the two arches. Previous serial cephalometric studies (Epstein, 1948) have indicated that this is accomplished by a distal movement of the maxillary arch or by a holding of that arch until mandibular growth overtakes it. It now seems probable that such changes must equal not only the discrepancy in the molar relation but also the amount that the condyle must move to seat itself properly in the fossa. In adult cases, in which no effort is made to shift the molar relation but rather to improve esthetics by the extraction of the premolars and the retraction of the incisors, the condyle moves back only as the maxillary incisors do so.

It would be regrettable if the findings here set forth should become the excuse for the undertaking of empirical procedures designed to reposition the mandible. I feel that the concept of the rest position of the mandible is still valid and that the normal rest position is characterized by a condyle well seated in the glenoid fossa. I do believe, however, that the resting position may vary from this typical condition if the skeletal pattern is not typically normal, but that such an accommodation position is equally stable. Only a change of functional parts will bring about a change in the rest position.

Further studies are indicated in the fields of speech, deglutition, and general muscle physiology before we shall be in a position to understand fully the intricate pattern of mandibular function.

REFERENCES

1. Björk, Arne: The Nature of Facial Prognathism and Its Relation to Normal Occlusion of Teeth, AM. J. ORTHODONTICS **37**: 106-124, 1951.
2. Blume, Dayton: A Roentgenographic Study of the Position of the Mandible in Malocclusion of the Teeth, Class II, Division 1 (Angle), Thesis, Northwestern University Dental School, Department of Orthodontics, 1947.
3. Boman, Vernon: A Roentgenographic Study of the Position of the Mandible in Normal Occlusion of the Teeth, Thesis, Northwestern University Dental School, Department of Orthodontics, 1948.
4. Brader, Allen C.: The Application of the Principles of Cephalometric Laminagraphy to the Studies of the Frontal Planes of the Human Head, AM. J. ORTHODONTICS **35**: 249-268, 1949.
5. Broadbent, B. Holly: A New X-ray Technique and Its Application to Orthodontia, Angle Orthodontist **1**: 45-66, 1931.
6. Brodie, Allan G., Downs, Wm. B., Goldstein, Abraham, and Myer, Ernest: Cephalometric Appraisal of Orthodontic Results, Angle Orthodontist **8**: 261-351, 1938.
7. Brodie, A. G.: Late Growth Changes in the Human Face. (In press.)
8. Downs, Wm. B.: Variations in Facial Relationship: Their Significance in Treatment and Prognosis, AM. J. ORTHODONTICS **34**: 10, 1948.
9. Downs, Wm. B.: The Role of Cephalometrics in Orthodontic Case Analysis and Diagnosis, AM. J. ORTHODONTICS **38**: 162-182, 1952.
10. Epstein, Walter N.: Analysis of Changes in Molar Relationships by Means of Extra-Oral Anchorage (Head Cap) in Treatment of Malocclusion, Angle Orthodontist **17**: 63-69, 1948.
11. Lande, Milton: Growth Behavior of the Human Bony Facial Profile as Revealed by Serial Cephalometric Roentgenology. (In press.)
12. Thompson, John R., and Brodie, Allan G.: Factors in the Position of the Mandible, J. Am. Dent. A. **29**: 925-941, 1942.
13. Thompson, John R.: The Rest Position of the Mandible and Its Significance to Dental Science, J. Am. Dent. A. **33**: 151-180, 1946.

15247 SUNSET BLVD.

THE INFLUENCE OF DENTOFACIAL ASYMMETRIES UPON TREATMENT PROCEDURES

Edward A. Cheney, D.D.S., M.S., Lansing, Mich.

It is evident to all orthodontists that there are many kinds of dentofacial variations. One of these results from anteroposterior discrepancies between dental arches. Another has to do with the relationship of the teeth to their supporting bone. In still another type the variation results from differences in the size, shape, and position of one part of the dentofacial complex as compared with the same part on the opposite side of the face. In addition, there are other variations. For the most part, however, this discussion will deal with those types just described. The anteroposterior discrepancies will be considered as displacements. An excess of tooth structure as compared with supporting bone will be called a deficiency. The variations resulting from differences between similar facial parts will be termed asymmetries. The major consideration will deal with asymmetries. The article will discuss the influence of asymmetries upon treatment procedures.

Historically *balanced occlusion* has been a main point of attention in orthodontic considerations. Balanced occlusion means a stable relationship between the teeth and their supporting bone. The literature presents many concepts, diagnostic methods, and treatment techniques designed and intended to balance occlusion. Some early workers emphasized the ideal alignment of all teeth as the best way to attain this objective. Angle[1] said, "When normal occlusion obtains, or has been established through treatment, the face has attained its fullest harmony and beauty." Angle insisted on a full complement of teeth regardless of the size and shape of the supporting jaws. His analysis and treatment procedures were based upon an ideal relationship of all teeth to the maxillary first molar. The attainment of this was labeled balanced occlusion by Angle. Other early workers were not in complete agreement with the Angle concepts. Even so they did not underestimate his point of view. Case[2] was quick to recognize Angle's hypothesis as basically sound. He pointed out "correction with proper maintenance or attainment of a normal occlusion without the loss of permanent teeth is indispensable to normal dentofacial relation." However, he realized *orthodontic limitations* and suggested, "One of the greatest errors in this teaching, is that whatever the irregularity or facial deformity, the main and indispensable object in the practice of Orthodontia is to place the dentures in normal occlusion." He further explained, "Today a very large proportion of orthodontists who are striving for the highest attainments in their specialty, have learned by experience the dangers of this arbitrary and autocratic teaching and are endeavoring to treat their patients according to facial as well

This thesis, which was given as a partial requirment for certification by the American Board of Orthodontics, is being published with the consent and the recommendation of the Board, but it should be understood it does not necessarily represent nor express the opinion of the Board.

as occlusal demands." In the years that followed, Lundstrom[3] presented his studies about apical base, Simon[4] brought out the diagnostic technique of gnathostatics, and Hellman[5] urged the recognition of the variations in occlusion and further explained the limitations of orthodontic treatment. In recent years Tweed[6] has been the primary advocate of extraction as the most reasonable method of balancing tooth and jaw relationships. The cephalometric appraisal of head x-rays was initiated by Broadbent.[7] Brodie,[8] Margolis,[9] McDowell,[10] and others have used this technique to evaluate dentofacial relationships. Downs[11] has developed a detailed diagnostic method by measuring the angular relationships between the teeth and supporting bones. Wylie[12] has assessed the influence of anteroposterior dysplasia. Many researchers and practitioners have contributed to these and other types of dentofacial analyses. All efforts have been centralized about how best to balance occlusion. This is as it should be since these added details enable a better understanding of patients and a more skillful practice of orthodontics.

As we continue with the literature we note that much attention has been given to anteroposterior displacements and to dentofacial deficiencies. With few exceptions, no attention has been given to the influence of asymmetries in the production of malocclusion or to the significance of these variations upon treatment procedures. The exceptions have dealt almost entirely with mandibular resections. There are many dentofacial asymmetries which produce malocclusion. When present in the individual the influence of asymmetries must be evaluated. We do not imply that these disharmonies have been ignored by the profession. Quite to the contrary, the appraisal of asymmetries is an integral part of the orthodontic instruction at the University of Michigan. Presumably this is true in other departments throughout the field and in practice. We only note that the influence of asymmetries upon treatment procedures has not been emphasized in the literature to date. Let us, then, examine them as they are significant in the production and treatment of malocclusion.

Asymmetries occur commonly. They vary considerably in type and intensity. There is much overlap in the forms that they take. As we study cases of this type, it becomes increasingly apparent to all of us that there are many combinations of asymmetrical development. All of us have seen rotations of the maxilla, modifications of the palate, and so-called rotations of the mandible. In addition all of us have observed differences in size between the right and left mandibular rami and differences in size and shape between the body of the mandible on the right and the body of the mandible on the left. Moreover, we know that displacements of the various quadrants within the dental arch occur in the human dentition. There are a number of methods which permit an evaluation of dentofacial asymmetries. The anthropologic technique of appraisal is one well adapted to analyzing these relationships. An introductory insight to this method has been presented by Moore and Hughes[13] in their article about familial factors. An examination of this type is shown in Fig. 1. This individual combines a number of these disharmonies and demonstrates the influence of asymmetries. Looking at the front view of the face, it appears that the patient has tilted his head to the right. A closer appraisal reveals that the right side of the face has developed differently from the left. The right infraorbital area

is not as well developed. The nasal ridge is twisted. When related to a horizontal plane, the right eye is slightly inferior. The lateral view of this individual reveals differences in the height of the rami. The markings shown here indicate the heads of the condyles and the angles of the mandible. As demonstrated, the right ramus is shorter than the left. The lower left illustration in this figure reveals the extent of the right maxillary displacement. The patient's head is tipped back, and the view is from below. The lower right illustration is an appraisal of the inferior border of the mandible. Here, again, the patient's head is tipped far back. My assistant's index fingers have localized the posterior borders of the angles of the mandible. Close observation reveals that the right mandibular body is longer than the left. Also, there is a rotation of the body of the mandible to the right as indicated by the position of the symphysis slightly to the right of the nasal septum. The intraoral relationships of this individual are shown in Fig. 2. The upper view reveals a distal displacement of the right maxillary dental arch. On this side the dentition is well balanced to its displaced maxillary apical base. On the left the maxillary dental arch is complicated by crowding. In contrast, in the lower arch there is fairly good symmetry and a better balance between the size of the teeth and their supporting structure.

Fig. 1.

In this case we have a curious combination of asymmetrical relationships. On the right side of the face there is a displaced maxilla, a short ramus, and a long mandibular body. On the left there is a prominent maxilla, a long ramus, and a short mandibular body. The resulting dentition is shown in Fig. 3. It is an Angle Class II malocclusion. The distocclusion is more accentuated on the left than on the right. The patient had a history of premature loss of the right maxillary primary second molar and may have had a slight mesial drift of the first permanent molar in this area. The Class II relationship on the left

is not as easily explained. All other primary teeth exfoliated normally. From this history it appears that the large right mandibular body has adequate compensated for the short ramus and the displaced maxilla on the right side of the face. On the left the forward placement of the maxillary arch has carried this quadrant mesially, as related to the mandibular arch, and has resulted in a Class II relationship.

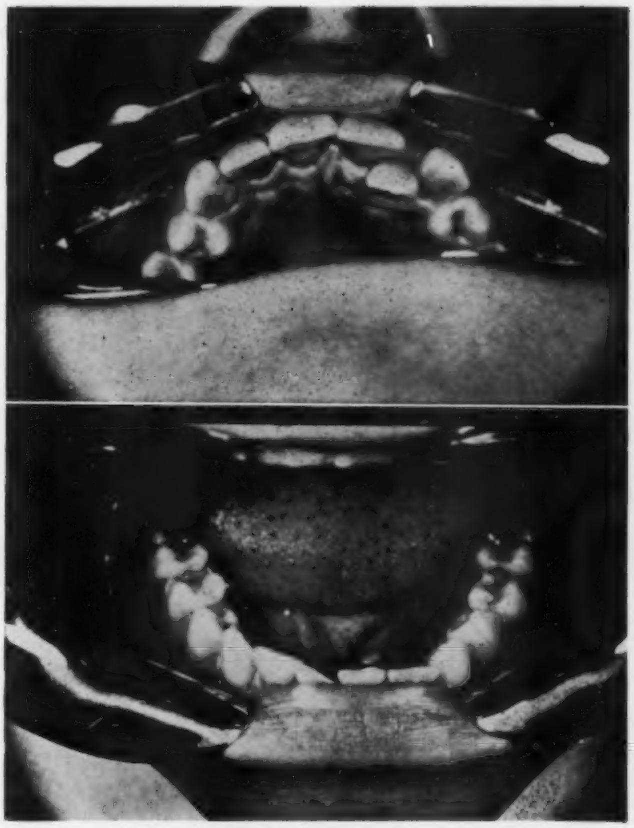


Fig. 2.

There can be many types and combinations of asymmetrical development. Some types involve the deep-seated structures of the apical base areas. Others occur within the various portions of the dental arch. Still others result from differences in the size and shape of the arches in opposing jaws. Whenever these and other asymmetries occur the nature of the problem is likely to be individually peculiar. Accordingly, there can be no fixed rules or patterns of treatment for the correction of these malocclusions. In many individuals one side of the face is different from the other. In these cases it is advisable to plan treatment to deal with the various portions of the dentition according to their various needs. It is unreasonable to assume that every orthodontic treatment plan must be bilateral in nature. For example, Fig. 4 shows a malocclusion complicated by the presence of an asymmetrical maxilla. The casts shown here are not gnathostatic records. However, they have been trimmed to approximate the relationship of the dentition to the other portions of the dentofacial complex and serve to illustrate the discussion.

The occluded casts show that the malocclusion is an Angle Class II, Division 1, subdivision left. The maxillary incisors are markedly protrusive, and there is an overjet of one-half inch. The occlusal views in this slide reveal that neither arch has perfect symmetry. The maxillary arch, however, shows more deviation

Fig. 3.

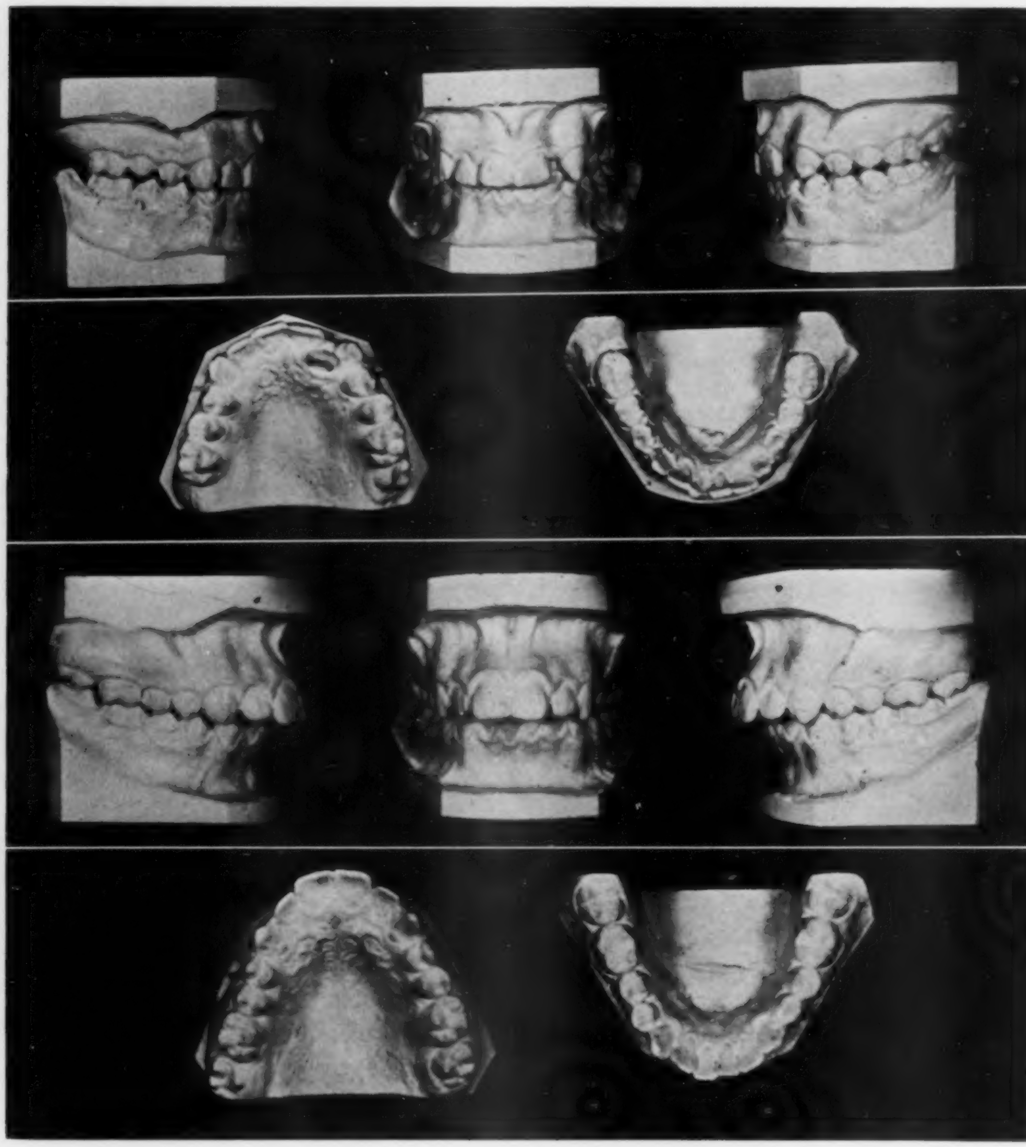


Fig. 4.

than the mandibular. During the clinical examination we observed the relationship of the upper dentition to the patient's skull. As shown here, the maxilla is slightly rotated. The anterior portion of the upper arch is turned to the right. The maxillary median raphe does not form a right angle with the orbital

plane. The upper and lower midlines do not coincide. On the other hand, the mandible is more symmetrical than the maxilla when compared with adjacent facial parts.

Fig. 5.

Fig. 6.

Several considerations are of interest in the appraisal of this case. These dental arches are not small. Yet both are narrow and trapezoidal in nature. There is little opportunity for modification of the arches upon their bases. Because of the presence of the asymmetry, we did not attempt to move the left maxillary dental quadrant distally. Neither did we resort to extensive extraction procedures. Instead we elected to "fit" the maxillary arch to its supporting base. As shown in Fig. 5 we extracted the maxillary left first premolar and

retruded the incisors and left canine into this space. The front view of these casts taken one year after the end of treatment reveals that the midlines now coincide. The maxillary arch is almost U-shaped, and the anterior part of the mandibular arch has been rounded out to occlude with it.

As demonstrated here, the presence of asymmetries within the apical base areas will dictate the needs in our treatment procedures. Because of disharmonies in the shape of supporting structures, we are limited in our attempts to reorganize the dentition. We cannot modify the basal bone. We can only modify the dental arches. Accordingly, we develop a treatment plan which allows us to balance the dentition to the individual with whom we are dealing. In this case, the extraction of one tooth enabled this balancing and provided a result which adequately meets the needs of the individual. In addition, this result fulfilled our responsibility of providing health and appearance for the patient without committing him to extensive extraction procedures which would have been in excess of his demands.

Fig. 6 shows another type of asymmetry which is often encountered. In this individual the clinical examination revealed no asymmetries of the basic structures. Instead we noted mesial displacement of one buccal segment within each dental arch. The occluded casts reveal an Angle Class II, Division 1, subdivision malocclusion. The occlusal view of the upper arch shows that the right quadrant is mesial to the quadrant on the left side of the arch. The mandibular arch is modified in a similar manner. Here, however, the displaced quadrant is on the left. As a result of these two displacements, there is crowding in one canine area of each arch. Further examination reveals that the dental arches are midway between tapering and trapezoidal in nature. Although the alveolar bone is massive, it is doubtful that these arches can accommodate a full complement of well-aligned teeth.

In this case there are more facts than have been shown here. During the initial visit the mother indicated that she did not want her daughter to be "toothy." She, more so than the daughter, had prominent midfacial features. The mother's dentition, although not ideal, was esthetically satisfactory. It was a dentition composed of fairly large teeth supported in massive alveolar processes. The dentofacial complex was well balanced with the remainder of the skull. However, she was dissatisfied with it and wished to avoid a repetition in her daughter. In view of the demands of the patient, we elected to extract teeth to balance the dentition to the needs of the patient.

Now almost any extensive extraction plan would have been well accepted by this individual. The parents were ready to support such a plan. However, in view of the more than adequate supporting bone of the patient and in view of the problem of managing spaces following the excessive removal of premolars, it seemed advisable to proceed cautiously. We elected to relieve only the crowding occurring in each arch. We explained to the mother that this procedure would best balance the teeth to the supporting bone. In addition, we advised that more teeth could be removed if the appearance was unsatisfactory. Accordingly, we extracted the maxillary right premolar and the left mandibular central incisor. The lower central incisor was selected over the lateral incisor because it was smaller. We wished to provide adequate space but did not want

to reduce the size of the dental arch. Our measurements assured us that the space occupied by the central incisor would be adequate. In addition, the lateral incisor needed only to be uprighted into this space and its presence in the arch during treatment reduced the tendency for the canine to tip the mesial.

Fig. 7.

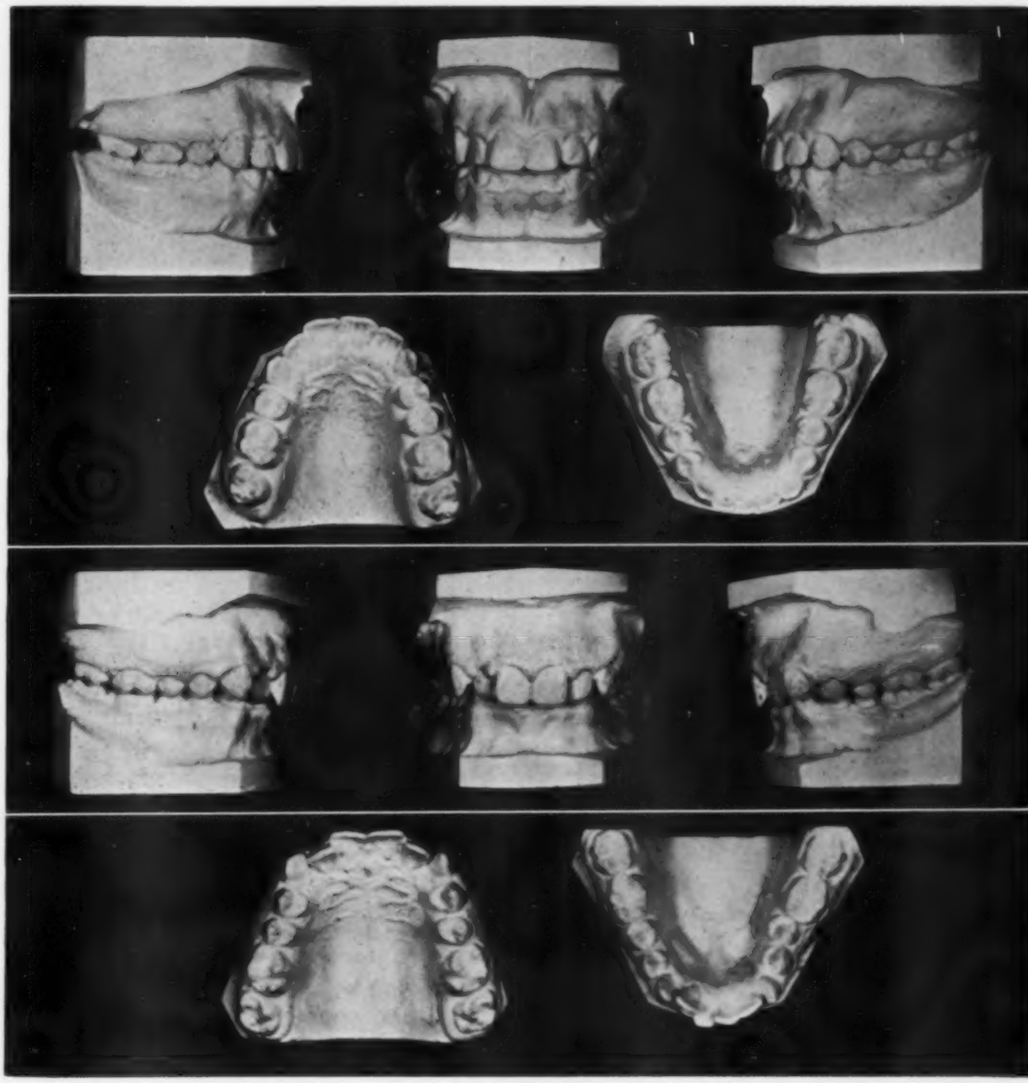


Fig. 8.

The treatment results are shown in Fig. 7. This change required ten months. The relationship of the posterior teeth has not been altered. The occlusal view of the upper arch reveals that the maxillary right canine has moved distally into the premolar space, and the adjacent central and lateral incisors have been retruded and realigned slightly to the right of their former position. The mandibular left lateral incisor and canine have moved into the space created by the extraction of the central incisor. No attention has been

paid to balancing of midlines. The lateral incisor in the lower arch is centered in the anterior portion of the jaw and is directly opposite the mesial margins of the maxillary central incisors. The individual arches are well related to the supporting alveolar bone and apical bases. In addition, the teeth in each arch are well aligned and are balanced with those in the opposing arch. Minor occlusal adjustment facilitated the latter relationship. Selective grinding of the occlusion is often necessary following the correction of any type of malocclusion.

The judicious removal of teeth designed to balance the dentition to its supporting structures is adequate in most of the borderline deficiency malocclusions which are complicated by the presence of asymmetries. Correct anatomical relationships, although highly desirable, are not necessary. On the other hand, the excessive use of extraction, initiated in an effort to attain bilateral balanced occlusions, often creates enormous problems of space management and commits the patient to additional treatment which is of no value to him. By the same token, the dogmatic retention and wholesale movement of teeth in an effort to develop perfect dental balance can be equally undesirable. Moreover, this treatment can provide impossible retention problems which are discouraging to the patient. Whenever possible, then, it seems only reasonable to consider treatment procedures on the basis of the individual's needs. In the presence of asymmetries we can attempt to modify the dentition to its supporting structures with a minimum of extraction before launching into an extensive program which may be in excess of the needs of the patient.

In addition to asymmetries within jaws there are asymmetries between jaws. An asymmetry of this type is shown in Fig. 8. The examination of these casts reveals an Angle Class II, Division 2 malocclusion. The maxillary central and lateral incisors are crowded and slightly retruded. There is a deep impinging overbite. The left mandibular premolars are in lingual version to their opponents. The occlusal views reveal the asymmetry in this dentition. The maxillary arch is broad and nearly U-shaped. The mandibular arch is a narrow, nearly tapering, trapezoidal type. The disharmony results from a difference between the shapes of the dental arches.

Asymmetries resulting from differences in the shape of the opposing dental arches are not uncommon. Angle Class III malocclusions often exhibit these discrepancies. In many cases it is impossible to attain any degree of dental balance, and we are forced to compromise with these ideas and fit the teeth in the upper jaw to those in the lower jaw as well as to the bone which supports them. In extreme cases we resort to surgical techniques. In Angle Class II malocclusions similar relationships can be observed. Sometimes we extract teeth from oversize maxillary arches in order to modify them to the shape of the lower arches. In other cases it seems more advisable to retain and align teeth when this procedure meets the needs of the individual.

The patient whose casts are shown here, for example, was referred to us by a periodontist. The periodontist was concerned with the partially impinging deep bite and the lingually locked mandibular left premolars. Neither he nor the parents of this boy were greatly concerned about the appearance of the teeth. The patient's appearance was similar to that of his father who also had an Angle Class II, Division 2 malocclusion with a deep, but not impinging,

overbite. The father was experiencing minor periodontal disturbances involving the mandibular incisor supporting structures. The mother had small trapezoidal arches. Her teeth were small and well aligned. The patient occasionally developed palatal irritations due to impingement of the mandibular left canine and right lateral incisor. The periodontist was much disturbed by these conditions and asked for a reduction of the overbite and a repositioning of the lingually posed mandibular premolars.

As we continue to examine the dentition illustrated by Fig. 8, we note that the maxillary basal bone development is adequate to support all teeth. On the other hand, the mandibular arch is deficient and unable to accommodate all teeth. Yet, in this case there is need for treatment to create a healthy, well-balanced dentition. Any discussion about the management of a dentition complicated by this type of asymmetry can become highly controversial. Yet in the consideration of factors which direct our thinking about the management of malocclusion, it is necessary to analyze the problems arising from disharmonies of this nature. There are several views which can be taken of this case. The situation can be called untreatable and the case dismissed. Yet, if orthodontics proposes to accept its full responsibility as a health service, problems of this type must be given full consideration no matter how difficult the treatment may be. The opportunitiy to assist other branches of dentistry enables us to demonstrate the real significance of orthodontic services in maintaining the natural dentition for the purposes it serves. Accordingly, in the case shown here, it seemed advisable to develop a treatment plan best suited to the needs of the individual. In this consideration, attention was given to the advantage of extraction procedures. At first the removal of teeth seemed strongly indicated. The mandibular arch would have benefited considerably. On the other hand, extraction in the maxillary arch would have created excessive spacing and would have resulted in a real problem of managing the closure of it. As illustrated in Fig. 8, there was already spacing in the upper left premolar region. It also seemed probable that during treatment, following extraction, the maxillary incisors would be tipped to the lingual as we closed the premolar spaces. In our opinion, this action seemed undesirable in view of the needs of the individual. It seemed to us that treatment along these lines would create an overbite relationship far more unstable than the one shown here. Accordingly, we elected to manage the malocclusion without removing teeth. We advised the parents and patient that semiactive retentive devices would be needed for a long time following treatment and that this need resulted from the presence of different-shaped upper and lower arches which could not be completely balanced one to the other. In addition, we explained to the referring dentist that some crowding would remain in the lower arch. In our opinion this plan of treatment was designed to meet the health needs of the patient better than one involving extensive extraction procedures. Moreover, it did not commit us to a plan from which we could not withdraw.

Casts shown in Fig. 9 reveal the direction in which the treatment now is progressing. They were taken several months after corrective procedures were initiated. The maxillary posterior arch has been expanded. Even so, these

teeth have not been moved off the apical base. There is now even more spacing in the maxillary premolar regions. The upper and lower incisors have been aligned. In contrast to the upper central arch, the lower now almost exceeds its apical base. This change was expected. The anteroposterior arch relationship is also of interest in this consideration. Following the labial tipping of the maxillary incisors, the molar relationship changed on its own accord to an Angle Class I relationship. No intermaxillary fraction was used.

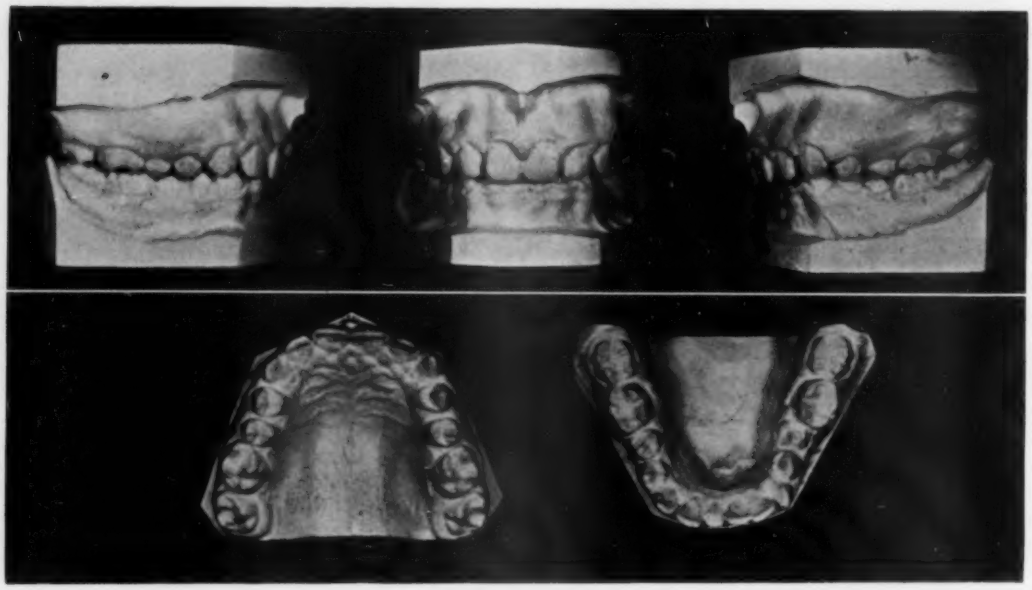


Fig. 9.

Now, whether you agree or do not agree with this treatment plan is not important. It is important, however, that we recognize the variations which occur within and between the dental arches of the individuals with whom we deal. Whenever different-shaped arches occur within the dentofacial complex there is considerable limitation in the extent to which treatment can be carried. Usually it is difficult to attain ideal occlusion in these cases. As in other types of asymmetries, we are forced many times to recognize the relationship and balance the dentition for the purposes it serves. Some of these adjustments will be highly satisfactory; some will not. In any case, however, we can never ignore the need for service even though ideal and perfect results are not forthcoming.

Whenever we consider the influence of dentofacial asymmetries upon treatment procedures care must be taken to differentiate between the real asymmetries involving deep-seated variations between supporting structures and the functional asymmetries which result from local causes. The treatment problems of the latter are far different than those which have been discussed. During the closure from rest position to contact occlusion, the presence of malposed teeth, constricted maxillary dental arches, abnormal occlusal wear or attrition, improperly contoured restorations, and other local irritations can cause the mandi-

ble to deviate to a position which is not true centric. By virtue of this deviation, or shift, the face can acquire the appearance of being asymmetrical. The mandibular shift is for convenience in mastication. Often the facial disharmony is very obvious. If permitted to function from the early stages of development to adulthood these irregularities become permanent. In the adult stages the removal of the local cause will no longer enable a return of the mandible to its true centric and the disharmony must be looked upon as a deep-seated asymmetry. Although there is no question that development and elaboration of this problem are warranted, the paper will not deal further with these asymmetries. However, I wish to emphasize that it is important to recognize and remove these irregularities from growing dentitions as early as possible. They must always be differentiated from those asymmetries developing out of deep-seated dentofacial variations. Thompson[14] has suggested that the examination of the occlusion with the jaws in rest position reveals the true relationship of the basic dentofacial structures. This technique removes the influences of disturbing irregular teeth for the moment. We can then observe the movement of the mandible from rest position to contact occlusion and detect the deviations of the mandible when they are present.

In conclusion, the role of a particular type of disharmony in the evaluation and treatment of malocclusion has been discussed. The labeling of these disharmonies as asymmetries calls attention to an important class of dentofacial variations. Their presence requires special consideration in the serious problem of balancing the extensive array of structures which provide the basis of occlusion and the functional unit of the head as a whole.

REFERENCES

1. Angle, E. H.: Treatment of Malocclusion of the Teeth and Fractures of the Maxillae, ed. 1, Philadelphia, 1889, The S. S. White Dental Mfg. Co.
2. Case, Calvin S.: Dental Orthopedia and Prosthetic Correction of Cleft Palate, ed. 2, Chicago, 1921, The Lakeside Press.
3. Lundstrom, Axel: Malocclusion of the Teeth Regarded as a Problem in Connection With the Apical Base, Stockholm, 1923, A. B. Fahlerantz.
4. Simon, P. W.: Fundamental Principles of a Systematic Diagnosis of Dental Anomalies (translated by B. E. Lischer), Boston, 1926, Stratford Company.
5. Hellman, Milo: Variations in Occlusion, Dental Cosmos **63**: 608-619, 1921.
6. Tweed, Charles H.: Indications for the Extraction of Teeth in Orthodontic Procedure, Am. J. Orthodontics and Oral Surg. **30**: 405-428, 1944.
7. Broadbent, B. H.: A New X-Ray Technique and Its Application to Orthodontia, Angle Orthodontist **1**: 45-66, 1931.
8. Brodie, A. G.: Behavior of Normal and Abnormal Facial Growth Patterns, Am. J. Orthodontics and Oral Surg. **27**: 633, 1941.
9. Margolis, H. I.: A Basic Facial Pattern and Its Application to Clinical Orthodontics, Am. J. Orthodontics and Oral Surg. **33**: 631-641, 1947.
10. McDowell, R. M.: The Use of Lateral Head Radiographs for Evaluating Orthodontic Results as Distinguished From Growth Changes, Am. J. Orthodontics and Oral Surg. **27**: 59-74, 1941.
11. Downs, Wm. B.: Variations in Facial Relationships: Their Significance in Treatment and Prognosis, Am. J. Orthodontics **34**: 812-840, 1948.
12. Wylie, W. L.: The Assessment of Anteroposterior Dysplasia, Angle Orthodontist **17**: 97-109, 1947.
13. Moore, G. R., and Hughes, B. O.: Familial Factors in Diagnosis, Treatment, and Prognosis of Dentofacial Disturbances, Am. J. Orthodontics and Oral Surg. **28**: 603-639, 1942.
14. Thompson, J. R.: The Rest Position of the Mandible and Its Significance to Dental Science, J. Am. Dent. A. **33**: 151-180, 1946.

In Memoriam

SIDNEY BLAINE HOSKIN

1890-1952

SIDNEY BLAINE HOSKIN, very good friend and able counselor to many of his professional brothers, died Sept. 7, 1952, at the age of 62, in Portland, Ore. Many men have been leaders as Sid was in the many professional and fraternal and civic organizations, but not all were able to convey the heartfelt warmth to the job that Sid inspired. It is one thing to lead by strength, but quite another to lead by close communion of kindly feelings. The Pacific Coast Society was indeed fortunate for the years that he gave as Board member and president.

He was a member of the American College of Dentists, and a recognized leader in the field of orthodontics, having attended the Dewey School, and later was certified by the American Board of Orthodontics. A member of Xi Psi Phi fraternity, he was also a leading sportsman, and a leading advocate of game conservation programs. He served in the Dental Corps in World War I.

Sid was born in Iowa and later moved to Oregon. He was graduated from North Pacific College in 1916, and had specialized in orthodontics since 1921. Apparently friendliness and kindness were family traits as it is noteworthy that some of the classmates of 1916 still talk about the wonderful student days when they went to Sid's parents' farm for sincere hospitality, and real country dinners.

Sid is survived by his wife, June, and a son, Norman, to whom we extend our deep sympathy.

JOHN EDGAR RICHMOND

1882-1952

JOHN EDGAR RICHMOND, of Eugene, Ore., died Thursday, Sept. 25, 1952, at the age of 70. Well known and well liked over a goodly part of the country, "Deacon" Richmond had served as a dentist in Southwestern Oregon for more than forty-five years.

He was born Aug. 8, 1882, in Shelby, Mich., and came to Springfield, Ore., with his family in 1904. He was graduated from North Pacific Dental School, Portland, Ore., in 1907, and practiced in Oregon and Southern California. In 1919 he moved his main office from Springfield to Eugene and practiced orthodontics exclusively.

In addition to his many professional societies he was past-president of the Rotary Club, and Chamber of Commerce in Eugene.

As a hobby he wrote poetry which has been published in many journals and in book form. Most revealing as to the kindly and modest nature of the "Deacon" is this characteristic offering from the introduction to his book:

> To all those who in past years
> Have hailed my verse with modest cheers,
> And e'en sometimes did compliment,
> If not the verse, the good intent;

To those who said, "It's very good"
And those who on their honor stood
And said, "It could be worse,"
I dedicate—this book of verse.

With deep-seated love for his country at peace or at war, "Deacon" is well remembered in his community as the doctor who taught so many young and old the historical significance of the American flag. Over the years he became an authority on the subject.

He is survived by his wife, two daughters: Mrs. Donna James, of McMinnville, and Mrs. Dorothy Neet, Oakridge; one son, Robert K. Richmond, Eugene; six grandchildren and two sisters: Mrs. Myrtle Hall, of Lander, Wyo., and Mrs. Emma Wise, of Kalamazoo, Mich.

WILLIAM OLIVER TALBOT

1873-1952

WILLIAM OLIVER TALBOT, a Fort Worth, Texas, dentist, died in Fort Worth Tuesday, Oct. 14, 1952.

Dr. Talbot pioneered the practice of orthodontics in the state of Texas. While he never specialized in orthodontics, he did devote much time and thought to its practice during the early years of the specialty.

Dr. Talbot was a resident of Fort Worth for forty-two years. He pioneered dental research on the care and preservation of teeth. In 1950 Dr. Talbot was named the most representative dentist in Texas. He promoted introduction of a program of proper diet and care of teeth in Mississippi public schools and had experimented with fluoridation of water as a means of preserving teeth.

He was a trustee of the American Dental Association and a member of the Texas State Board of Dental Examiners. He was very active in the affairs of the American Dental Association for many years.

ABRAHAM WOLFSON

1894-1952

ABRAHAM WOLFSON died at his home, 16 Ely Place, East Orange, N. J., on July 18, 1952. He attended Purdue and Columbia Universities and was graduated in 1917 from the former New Jersey Dental School at Jersey City. He was a diplomate of the American Board of Orthodontics.

Dr. Wolfson was a civic leader as well as a member and officer of many professional societies. At the time of his death he had served as Chief of the Orthodontic Section of the Beth Israel Hospital Dental Clinic for twenty-five years. He had been, at various times, a trustee of the Community Council of Essex County, Vice-President of the Welfare Federation of Newark and West Hudson, a President of the Jewish Family Service Association of Essex County, and a worker for the United Jewish Appeal and the Community Chest.

In addition to membership in many local and state dental organizations, Dr. Wolfson was, at the time of his death, Chairman of the Board of Censors of the Middle Atlantic Society of Orthodontists.

He was an active contributor to many dental and orthodontic programs and many of his articles appeared in various dental journals as well as the AMERICAN JOURNAL OF ORTHODONTICS. Included are such titles as: "Monson's Spherical Theory of Occlusion," "Construction of Study Models," "Profilograph," "The Importance of Proper Gingival Restoration in Orthodontic Treatment," "Improvement Upon Angle's Classification," "Deep Bites in Adults," "Band-Forming Pliers," and "Professional Success in Theory and Practice."

Dr. Wolfson was a designer of numerous items including a profilograph, a band-forming plier, history charts and occipital anchorage gearing and swivel hook.

He leaves his wife, two daughters, four sisters, and three grandchildren.

Department of Orthodontic Abstracts and Reviews

Edited by

DR. J. A. SALZMANN, NEW YORK CITY

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. J. A. Salzmann, 654 Madison Avenue, New York City

Tables for Predicting Adult Height From Skeletal Age: Revised for Use With the Greulich-Pyle Hand Standards: By Nancy Bayley, Ph.D., and Samuel R. Pinneau, M.A., Berkeley, Calif. Reprinted (with deletions) from *J. Pediat.* **40**: 423-441, April, 1952.

Recently the Todd *Atlas* has been completely revised by Greulich and Pyle. In their revision Greulich and Pyle have changed, somewhat, the criteria for determining normal skeletal age. . . . A given skeletal age as determined from the Greulich-Pyle *Atlas* will in most instances represent a different percentage of adult height than the same skeletal age read from the Todd *Atlas*. . . .

Our system of prediction is based on the fact that there is a high correlation between the skeletal ages, as read from hand x-rays on this type of standard, and the proportion of their adult stature achieved by children at the time their x-rays were taken. That is, SA (skeletal age) correlates with PMH (per cent of mature height) about .86 at most ages after 9 years, when chronological age is held constant. The new tables have been constructed from data gathered at the University of California Institute of Child Welfare, on 192 normal Berkeley children (103 girls and 89 boys) who were measured and x-rayed every six months (with occasional exceptions) from 8 years through 18 years, or until all epiphyses of the hand were closed. The tables were then validated by applying them to a different group of 46 children (23 boys and 23 girls).

Each child's height at maturity was taken as 100 per cent, and the fraction of his own mature height was computed for every earlier measuring. The average per cent of mature height (PMH) for a series of ages from one month to 18 years is shown in Fig. 1 and Table I for the Berkeley Growth Study children. The standard deviations from these means (shown by the shaded area in Fig. 1) indicate a wide spread, among these normal children, in the speeds at which they progress toward their eventual heights. When regrouped according to skeletal age, however, the spread of percentages is greatly reduced during the period of pubescence, as may be seen by the narrowness of the shaded area in the inset curves in Fig. 1. This is one indication of the close relationship between growth in size and the maturation of the skeleton, and demonstrates the usefulness of skeletal age in predicting future growth.

DIRECTIONS FOR TAKING X-RAYS AND MEASURING HEIGHT

In using the tables it is necessary to have a good assessment of skeletal age from an x-ray of the hand, an accurate measurement of height, and a record of the child's age. The following directions are given to facilitate obtaining these data.

X-rays are taken of the left hand, which is placed "palm down, hand flat on the film holder, with fingers slightly separated, and the axis of the hand, wrist, and forearm in a straight line. Center the tube half way between the tips of the fingers and distal end of the radius. The radiograph should include the complete fingers and at least 1½ inches of the radius, since all the hand

epiphyses as well as those of the distal end of the arm are very important in the skeletal age reading." For children over 6 years of age we have used no-screen cardboard holders. Good results may be obtained with a tube distance of 36 inches, time 1 second, 100 MA, 45-50KV. For use with these tables we recommend reading for SA by the Greulich-Pyle Standards, according to their directions.

TABLE I. MEANS AND STANDARD DEVIATIONS OF PER CENT OF MATURE HEIGHT ACHIEVED AT SUCCESSIVE AGES FROM BIRTH TO 18 YEARS BY THE CHILDREN OF THE BERKELEY GROWTH STUDY

C.A.		BOYS			GIRLS		
		N	MEAN	S.D.	N	MEAN	S.D.
Months	1	17	30.18	.77	20	32.40	1.44
	2	22	32.40	.93	21	34.51	1.56
	3	22	33.93	1.00	23	35.96	1.31
	4	22	35.21	.95	23	37.50	1.08
	5	22	36.50	.99	21	38.78	1.08
	6	22	37.67	.93	21	39.84	1.20
	7	22	38.44	.95	21	40.69	1.20
	8	22	39.22	1.10	23	41.79	1.37
	9	22	40.08	1.07	23	42.20	1.22
	10	22	40.80	1.14	23	43.09	1.37
	11	22	41.53	1.16	21	44.10	1.24
	12	22	42.23	1.04	21	44.67	1.42
	15	22	44.02	1.19	21	46.90	1.18
	18	20	45.64	1.34	19	48.76	1.37
	24	23	48.57	1.44	17	52.15	1.34
	30	23	51.14	1.40	18	54.75	1.22
Years	3.0	23	53.53	1.34	22	57.16	1.20
	4.0	22	57.72	1.38	22	61.84	1.45
	5.0	23	61.60	1.49	23	66.24	1.45
	6.0	23	65.31	1.58	23	70.29	1.60
	7.0	23	69.08	1.60	22	74.28	1.61
	8.0	22	72.40	1.68	23	77.57	1.87
	9.0	22	75.61	1.68	21	81.19	2.00
	9.5	21	77.21	1.66	20	83.03	2.13
	10.0	22	78.40	1.76	23	84.76	2.42
	10.5	23	79.82	1.77	22	86.85	2.71
	11.0	23	81.30	1.94	21	88.65	2.88
	11.5	23	82.54	2.00	21	90.81	3.06
	12.0	20	84.00	2.23	22	92.61	3.27
	12.5	21	85.43	2.49	21	94.72	2.61
	13.0	23	87.32	3.02	18	95.96	2.15
	13.5	21	89.22	3.57	18	97.17	1.70
	14.0	20	91.00	3.96	19	98.27	1.24
	14.5	20	92.60	3.85	19	98.74	.93
	15.0	20	94.60	3.74	21	99.31	.68
	15.5	21	96.00	3.31	21	99.54	.48
	16.0	22	97.09	2.71	21	99.62	.35
	16.5	20	97.95	2.12	20	99.75	.34
	17.0	20	98.79	1.43	22	99.95	.25
	17.5	20	99.28	1.01	19	99.91	.25
	18.0	21	99.55	.58	18	99.96	.11

Height is measured without shoes, the child "standing tall" against an accurately calibrated solid vertical surface. (A good quality two-meter stick or similar rule calibrated in inches can be firmly affixed beside a vertical board.) Heels and back are touching the wall, the head held in the Frankfort plane (the lower edge of the eye socket and the upper edge of the earhole on a horizontal line). A Baldwin square, which is essentially two boards joined at right angles and held in place by a cross piece, is brought down so that it rests firmly against the measuring scale and comes in firm contact with the top of the head. The height measurement is then read off of the scale at the lower edge of the square.

DIRECTIONS FOR USING THE TABLES

The Greulich-Pyle prediction tables are set up in the same way as the 1946 tables for the Todd standards, with supplementary tables for retarded and accelerated children at the younger ages. In each table the skeletal ages, by three-month intervals, are given across the top, with the corresponding PMH directly under its SA. Mature heights may be computed from these percentages, by dividing the child's height by the percentage which corresponds to his SA. Or, predicted height may be read off directly from the tables. It is important, for reliable prediction from the tables, to use the correct table for the child's sex (Tables II for boys and Tables III for girls), and to select the table suitable for his rate of maturing. When within one year of a child's chronological age, use Tables IIA or IIB for boys, IIIA or IIIB for girls; when accelerated a year or more, use Tables IIC and IID or IIIC and IIID; and when retarded a year or more, use Tables IIE or IIIE and IIIF.

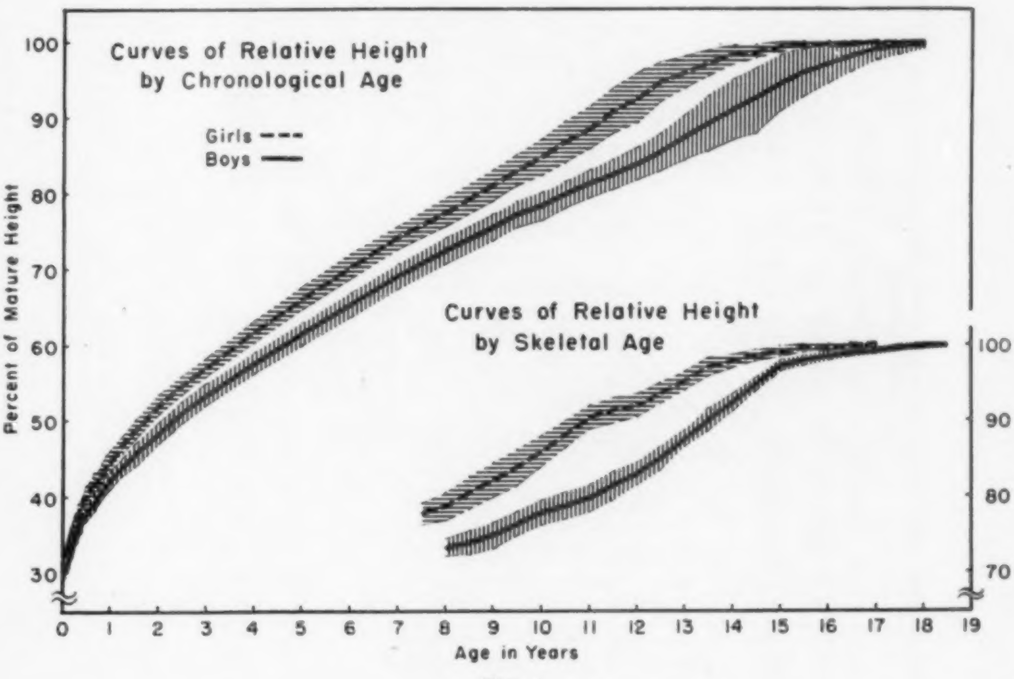


Fig. 1.

The most frequent mature heights have been computed for SA intervals of three months and height intervals of one inch. These predictions are given in the body of the tables. For example: A 13-year-old boy with an SA of 13 years 3 months is 60 inches tall. From Table IIB we find 60 inches in the left-hand column and follow across this row to the SA column of 13-3. The figure at this intersection, 67.4 inches, is the predicted mature height for this boy. If the measures or SA's do not fall exactly at the one-inch or three-month intervals, or are outside the range of prediction given in the table, we may interpolate, or make direct computations. For example, if the 13-year-old boy is only 51.5 inches tall, his mature height may be computed by dividing his present height by 89.0, which is the PMH for SA 13-3. This will predict an eventual height (or 100 per cent) of 57.9 inches.

Another boy may be 14 years old, 67½ inches tall, and have an SA of 15½ years. From Table IID we would predict a mature height from the 15-6 SA column at a point half way between 69 and 70 inches, or 69½ inches.

TABLE IIA. AVERAGE BOYS. PERCENTAGES AND ESTIMATED MATURE HEIGHTS FOR BOYS WITH SKELETAL AGES WITHIN ONE YEAR OF THEIR CHRONOLOGICAL AGES:

SKELETAL AGES 7 THROUGH 12 YEARS

Skeletal Age	**7-0**	7-3	7-6	7-9	**8-0**	8-3	8-6	8-9	**9-0**	9-3	9-6	9-9	**10-0**	10-3	10-6	10-9	**11-0**	11-3	11-6	11-9	12-0	12-3	**12-6**	12-9
% of Mature Height	69.5	70.2	70.9	71.6	72.3	73.1	73.9	74.6	75.2	76.1	76.9	77.7	78.4	79.1	79.5	80.0	80.4	81.2	81.8	82.7	83.4	84.3	85.3	86.3
Ht. (inches)																								
42	60.4																							
43	61.9	61.3	60.6	60.1																				
44	63.3	62.7	62.1	61.5	60.9	60.2																		
45	64.7	64.1	63.5	62.8	62.2	61.6	60.9	60.3																
46	66.2	65.5	64.9	64.2	63.6	62.9	62.2	61.7	61.2	60.4														
47	67.6	67.0	66.3	65.6	65.0	64.3	63.6	63.0	62.5	61.8	61.1	60.5												
48	69.1	68.4	67.7	67.0	66.4	65.7	65.0	64.3	63.8	63.1	62.4	61.8	61.2	60.7	60.4	60.0								
49	70.5	69.8	69.1	68.4	67.8	67.0	66.3	65.7	65.2	64.4	63.7	63.1	62.5	61.9	61.6	61.3	60.9	60.3						
50	71.9	71.2	70.5	69.8	69.2	68.4	67.7	67.0	66.5	65.7	65.0	64.4	63.8	63.2	62.9	62.5	62.2	61.6	61.1	60.5				
51	73.4	72.6	71.9	71.2	**70.5**	69.8	69.0	68.4	67.8	67.0	66.3	65.6	65.1	64.5	64.2	63.8	63.4	62.8	62.3	61.7	61.1	60.5	59.8	
52	74.8	74.1	73.3	72.6	**71.9**	71.1	70.4	69.7	69.1	68.3	67.6	66.9	66.3	65.7	65.4	65.0	64.7	64.0	63.6	62.9	**62.3**	61.7	61.0	60.3
53	76.3	75.5	74.8	74.0	73.3	72.5	71.7	71.0	70.5	69.6	68.9	68.2	67.6	67.0	66.7	66.3	65.9	65.3	64.8	64.1	63.5	62.9	62.1	61.4
54	77.7	76.9	76.2	75.4	74.7	73.9	73.1	72.4	71.8	71.0	70.2	69.5	68.9	68.3	67.9	67.5	67.2	66.5	66.0	65.3	64.7	64.1	63.3	62.6
55	79.1	78.3	77.6	76.8	76.1	75.2	74.4	73.7	73.1	72.3	71.5	70.8	70.2	69.5	69.2	68.8	68.4	67.7	67.2	66.5	**65.9**	65.2	64.5	63.7
56	80.6	79.8	79.0	78.2	77.5	76.6	75.8	75.1	74.5	73.6	72.8	72.1	71.4	70.8	70.4	70.0	69.7	69.0	68.5	67.7	**67.1**	66.4	65.6	64.9
57			80.4	79.6	**78.8**	78.0	77.1	76.4	75.8	74.9	74.1	73.4	72.7	72.1	71.7	71.3	70.9	70.2	69.7	68.9	68.3	67.6	66.8	66.0
58					**80.2**	79.3	78.5	77.7	77.1	76.2	75.4	74.6	74.0	73.3	73.0	72.5	72.1	71.4	70.9	70.1	**69.5**	68.8	68.0	67.2
59						80.7	79.8	79.1	78.5	77.5	76.7	75.9	75.3	74.6	74.2	73.8	73.4	72.7	72.1	71.3	70.7	70.0	69.2	68.4
60								80.4	79.8	78.8	78.0	77.2	76.5	75.9	75.5	75.0	74.6	73.9	73.3	72.6	**71.9**	71.2	70.3	69.5
61										**80.2**	79.3	78.5	77.8	77.1	76.7	76.3	75.9	75.1	74.6	73.8	73.1	72.4	71.5	70.7
62											80.6	79.8	79.1	78.4	78.0	77.5	77.1	76.4	75.8	75.0	74.3	73.5	72.7	71.8
63													80.4	79.6	79.2	78.8	78.4	77.6	77.0	76.2	**75.5**	**74.7**	73.9	73.0
64														80.9	80.5	80.0	79.6	78.8	78.2	77.4	**76.7**	75.9	75.0	74.2
65																	80.8	80.0	79.5	78.6	77.9	77.1	76.2	75.3
66																			80.7	79.8	79.1	78.3	77.4	76.5
67																					80.3	79.5	78.5	77.6
68																						80.7	79.7	78.8
69																							80.9	80.0

TABLE IIB. AVERAGE BOYS. PERCENTAGES AND ESTIMATED MATURE HEIGHTS FOR BOYS WITH SKELETAL AGES WITHIN ONE YEAR OF THEIR CHRONOLOGICAL AGES:

SKELETAL AGES 13 YEARS TO MATURITY

Skeletal Age	13-0	**13-3**	13-6	13-9	**14-0**	14-3	14-6	14-9	**15-0**	15-3	**15-6**	15-9	**16-0**	16-3	16-6	16-9	**17-0**	17-3	17-6	**17-9**	**18-0**	18-3	18-6
% of Mature **Height**	87.6	89.0	90.2	91.4	92.7	93.8	94.8	95.8	96.8	97.3	97.6	98.0	98.2	98.5	98.7	98.9	99.1	99.3	99.4	99.5	99.6	99.8	100.0
Ht. **(inches)**																							
53	60.5																						
54	61.6	60.7																					
55	62.8	61.8	61.0	60.2																			
56	63.9	62.9	62.1	61.3	60.4																		
57	65.1	64.0	63.2	62.4	61.5	60.8	60.1																
58	66.2	65.2	64.3	63.5	62.6	61.8	61.2	60.5															
59	67.4	66.3	65.4	64.6	63.6	62.9	62.2	61.6	61.0	60.6	60.5	60.2	60.1										
60	68.5	67.4	66.5	65.6	64.7	64.0	63.3	62.6	62.0	61.7	61.5	61.2	61.1	60.9	60.8	60.7	60.5	60.4	60.4	60.3	60.2	60.1	60.0
61	69.6	68.5	67.6	66.7	65.8	65.0	64.3	63.7	63.0	62.7	62.5	62.2	62.1	61.9	61.8	61.7	61.6	61.4	61.4	61.3	61.2	61.1	61.0
62	70.8	69.7	68.7	67.8	66.9	66.1	65.4	64.7	64.1	63.7	63.5	63.3	63.1	62.9	62.8	62.7	62.6	62.4	62.4	62.3	62.2	62.1	62.0
63	71.9	70.8	69.8	68.9	68.0	67.2	66.5	65.8	65.1	64.7	64.5	64.3	64.2	64.0	63.8	63.7	63.6	63.4	63.4	63.3	63.3	63.1	63.0
64	73.1	71.9	71.0	70.0	69.0	68.2	67.5	66.8	66.1	65.8	65.6	65.3	65.2	65.0	64.8	64.7	64.6	64.4	64.4	64.3	64.3	64.1	64.0
65	74.2	73.0	72.1	71.1	70.1	69.3	68.6	67.8	67.2	66.8	66.6	66.3	66.2	66.0	65.9	65.7	65.6	65.5	65.4	65.3	65.3	65.1	65.0
66	75.3	74.2	73.2	72.2	71.2	70.4	69.6	68.9	68.2	67.8	67.6	67.3	67.2	67.0	66.9	66.7	66.6	66.5	66.4	66.3	66.3	66.1	66.0
67	76.5	75.3	74.3	73.3	72.3	71.4	70.7	69.9	69.2	68.9	68.6	68.4	68.2	68.0	67.9	67.7	67.6	67.5	67.4	67.3	67.3	67.1	67.0
68	77.6	76.4	75.4	74.4	73.4	72.5	71.7	71.0	70.3	69.9	69.7	69.4	69.2	69.0	68.9	68.8	68.6	68.5	68.4	68.3	68.3	68.1	68.0
69	78.8	77.5	76.5	75.5	74.4	73.6	72.8	72.0	71.3	70.9	70.7	70.4	70.3	70.0	69.9	69.8	69.6	69.5	69.4	69.3	69.3	69.1	69.0
70	79.9	78.7	77.6	76.6	75.5	74.6	73.8	73.1	72.3	71.9	71.7	71.4	71.3	71.1	70.9	70.8	70.6	70.5	70.4	70.4	70.3	70.1	70.0
71		79.8	78.7	77.7	76.6	75.7	74.9	74.1	73.4	73.0	72.7	72.4	72.3	72.1	71.9	71.8	71.6	71.5	71.4	71.4	71.3	71.1	71.0
72		80.9	79.8	78.8	77.7	76.8	75.9	75.2	74.4	74.0	73.8	73.5	73.3	73.1	73.0	72.8	72.7	72.5	72.4	72.4	72.3	72.1	72.0
73			80.9	79.9	78.7	77.8	77.0	76.2	75.4	75.0	74.8	74.5	74.3	74.1	74.0	73.8	73.7	73.5	73.4	73.4	73.3	73.1	73.0
74					79.8	78.9	78.1	77.2	76.4	76.0	75.8	75.5	75.4	75.1	75.0	74.8	74.7	74.5	74.4	74.4	74.3	74.1	74.0
75					80.9	80.0	79.1	78.3	77.5	77.1	76.8	76.5	76.4	76.1	76.0	75.8	75.7	75.5	75.5	75.4	75.3	75.2	75.0
76							80.2	79.3	78.5	78.1	77.9	77.6	77.4	77.2	77.0	76.8	76.7	76.5	76.5	76.4	76.3	76.2	76.0
77								80.4	79.5	79.1	78.9	78.6	78.4	78.2	78.0	77.9	77.7	77.5	77.5	77.4	77.3	77.2	77.0
78									80.6	80.2	79.9	79.6	79.4	79.2	79.0	78.9	78.7	78.5	78.5	78.4	78.3	78.2	78.0

TABLE IIC. ACCELERATED BOYS. PERCENTAGES AND ESTIMATED MATURE HEIGHTS FOR BOYS WITH SKELETAL AGES ONE YEAR OR MORE ADVANCED OVER THEIR CHRONOLOGICAL AGES:

SKELETAL AGES 7 THROUGH 11 YEARS

Skeletal Age	7-0	7-3	7-6	7-9	8-0	8-3	8-6	8-9	9-0	9-3	9-6	9-9	10-0	10-3	10-6	10-9	11-0	11-3	11-6	11-9
% of Mature Height	67.0	67.6	68.3	68.9	69.6	70.3	70.9	71.5	72.0	72.8	73.4	74.1	74.7	75.3	75.8	76.3	76.7	77.6	78.6	80.0
Ht. (inches)																				
41	61.2	60.7	60.0																	
42	62.7	62.1	61.5	61.0	60.3															
43	64.2	63.6	63.0	62.4	61.8	61.2	60.6	60.1												
44	65.7	65.1	64.4	63.9	63.2	62.6	62.1	61.5	61.1	60.4										
45	67.2	66.6	65.9	65.3	64.7	64.0	63.5	62.9	62.5	61.8	61.3	60.7	60.2							
46	68.7	68.0	67.3	66.8	66.1	65.4	64.9	64.3	63.9	63.2	62.7	62.1	61.6	61.1	60.7	60.3	60.0			
47	70.1	69.5	68.8	68.2	67.5	66.9	66.3	65.7	65.3	64.6	64.0	63.4	62.9	62.4	62.0	61.6	61.3	60.6		
48	71.6	71.0	70.3	69.7	69.0	68.3	67.7	67.1	66.7	65.9	65.4	64.8	64.3	63.7	63.3	62.9	62.6	61.9	61.1	60.0
49	73.1	72.5	71.7	71.1	70.4	69.7	69.1	68.5	68.1	67.3	66.8	66.1	65.6	65.1	64.6	64.2	63.9	63.1	62.3	61.3
50	74.6	74.0	73.2	72.6	71.8	71.1	70.5	69.9	69.4	68.7	68.1	67.5	66.9	66.4	66.0	65.5	65.2	64.4	63.6	62.5
51	76.2	75.4	74.7	74.0	73.3	72.5	71.9	71.3	70.8	70.1	69.5	68.8	68.3	67.7	67.3	66.8	66.5	65.7	64.9	63.8
52	77.6	76.9	76.1	75.5	74.7	74.0	73.3	72.7	72.2	71.4	70.8	70.2	69.6	69.1	68.6	68.2	67.8	67.0	66.2	65.0
53	79.1	78.4	77.6	76.9	76.2	75.4	74.8	74.1	73.6	72.8	72.2	71.5	71.0	70.4	69.9	69.5	69.1	68.3	67.4	66.3
54	80.6	79.9	79.1	78.4	77.6	76.8	76.2	75.5	75.0	74.2	73.6	72.9	72.3	71.7	71.2	70.8	70.4	69.6	68.7	67.5
55			80.5	79.8	79.0	78.2	77.6	76.9	76.4	75.5	74.9	74.2	73.6	73.0	72.6	72.1	71.7	70.9	70.0	68.8
56					80.5	79.7	79.0	78.3	77.8	76.9	76.3	75.6	75.0	74.4	73.9	73.4	73.0	72.2	71.2	70.0
57							80.4	79.7	79.2	78.3	77.7	76.9	76.3	75.7	75.2	74.7	74.3	73.5	72.5	71.3
58									80.6	79.7	79.0	78.3	77.6	77.0	76.5	76.0	75.6	74.7	73.8	72.5
59											80.4	79.6	79.0	78.4	77.8	77.3	76.9	76.0	75.1	73.8
60													80.3	79.7	79.2	78.6	78.2	77.3	76.3	75.0
61															80.5	79.9	79.5	78.6	77.6	76.3
62																81.3	80.8	79.9	78.9	77.5
63																			80.2	78.8
64																				80.0

Table IID. ACCELERATED BOYS. Percentages and Estimated Mature Heights for Boys With Skeletal Ages One Year or More Advanced Over Their Chronological Ages:

Skeletal Ages 12 Through 17 Years

Skeletal Age	12-0	12-3	12-6	12-9	13.0	13-3	13-6	13-9	14-0	14-3	14-6	14-9	15-0	15-3	15-6	15-9	16-0	16-3	16-6	16-9	17-0
% of Mature Height	80.9	81.8	82.8	83.9	85.0	86.3	87.5	89.0	90.5	91.8	93.0	94.3	95.8	96.7	97.1	97.6	98.0	98.3	98.5	98.8	99.0
Ht. (inches)																					
49	60.6																				
50	61.8	61.1	60.4																		
51	63.0	62.3	61.6	60.8	60.0																
52	64.3	63.6	62.8	62.0	61.2	60.3															
53	65.5	64.8	64.0	63.2	62.4	61.4	60.6														
54	66.7	66.0	65.2	64.4	63.5	62.6	61.7	60.7													
55	68.0	67.2	66.4	65.6	64.7	63.7	62.9	61.8	60.8												
56	69.2	68.5	67.6	66.7	65.9	64.9	64.0	62.9	61.9	61.0	60.2										
57	70.5	69.7	68.8	67.9	67.1	66.0	65.1	64.0	63.0	62.1	61.3	60.4									
58	71.7	70.9	70.0	69.1	68.2	67.2	66.3	65.2	64.1	63.2	62.4	61.5	60.5	60.0							
59	72.9	72.1	71.3	70.3	69.4	68.4	67.4	66.3	65.2	64.3	63.4	62.6	61.6	61.0	60.8	60.5	60.2	60.0			
60	74.2	73.4	72.5	71.5	70.6	69.5	68.6	67.4	66.3	65.4	64.5	63.6	62.6	62.0	61.8	61.5	61.2	61.0	60.9	60.7	60.6
61	75.4	74.6	73.7	72.7	71.8	70.7	69.7	68.5	67.4	66.4	65.6	64.7	63.7	63.1	62.8	62.5	62.2	62.1	61.9	61.7	61.6
62	76.6	75.8	74.9	73.9	72.9	71.8	70.9	69.7	68.5	67.5	66.7	65.7	64.7	64.1	63.9	63.5	63.3	63.1	62.9	62.8	62.6
63	77.9	77.0	76.1	75.1	74.1	73.0	72.0	70.8	69.6	68.6	67.7	66.8	65.8	65.1	64.9	64.5	64.3	64.1	64.0	63.8	63.6
64	79.1	78.2	77.3	76.3	75.3	74.2	73.1	71.9	70.7	69.7	68.8	67.9	66.8	66.2	65.9	65.6	65.3	65.1	65.0	64.8	64.6
65	80.3	79.5	78.5	77.5	76.5	75.3	74.3	73.0	71.8	70.8	69.9	68.9	67.8	67.2	66.9	66.6	66.3	66.1	66.0	65.8	65.7
66		80.7	79.7	78.7	77.6	76.5	75.4	74.2	72.9	71.9	71.0	70.0	68.9	68.3	68.0	67.6	67.3	67.1	67.0	66.8	66.7
67			80.9	79.9	78.8	77.6	76.6	75.3	74.0	73.0	72.0	71.1	69.9	69.3	69.0	68.6	68.4	68.2	68.0	67.8	67.7
68					80.0	78.8	77.7	76.4	75.1	74.1	73.1	72.1	71.0	70.3	70.0	69.7	69.4	69.2	69.0	68.8	68.7
69						80.0	78.9	77.5	76.2	75.2	74.2	73.2	72.0	71.4	71.1	70.7	70.4	70.2	70.0	69.8	69.7
70							80.0	78.7	77.3	76.3	75.3	74.2	73.1	72.4	72.1	71.7	71.4	71.2	71.1	70.8	70.7
71								79.8	78.5	77.3	76.3	75.3	74.1	73.4	73.1	72.7	72.4	72.2	72.1	71.9	71.7
72								80.9	79.6	78.4	77.4	76.4	75.2	74.5	74.2	73.8	73.5	73.2	73.1	72.9	72.7
73									80.7	79.5	78.5	77.4	76.2	75.5	75.2	74.8	74.5	74.3	74.1	73.9	73.7
74										80.6	79.6	78.5	77.2	76.5	76.2	75.8	75.5	75.3	75.1	74.9	74.7
75											80.6	79.5	78.3	77.6	77.2	76.8	76.5	76.3	76.1	75.9	75.8
76												80.6	79.3	78.6	78.3	77.9	77.6	77.3	77.2	76.9	76.8
77													80.4	79.6	79.3	78.9	78.6	78.3	78.2	77.9	77.8
78														80.7	80.3	79.9	79.6	79.3	79.2	78.9	78.8

TABLE IIE. RETARDED BOYS. PERCENTAGES AND ESTIMATED MATURE HEIGHTS FOR BOYS WITH SKELETAL AGES ONE YEAR OR MORE RETARDED FOR THEIR CHRONOLOGICAL AGES:

SKELETAL AGES 6 THROUGH 13 YEARS

Skeletal Age	**6-0**	6-3	6-6	6-9	**7-0**	7-3	7-6	7-9	**8-0**	8-3	8-6	8-9	**9-0**	9-3	9-6	9-9	**10-0**	10-3	10-6	10-9	**11-0**	11-3	11-6	11-9	12-0	12-3	**12-6**	12-9	13-0
% of Mature Height	68.0	69.0	70.0	70.9	71.8	72.8	73.8	74.7	75.6	76.5	77.3	77.9	78.6	79.4	80.0	80.7	81.2	81.6	81.9	82.1	82.3	82.7	83.2	83.9	84.5	85.2	86.0	86.9	88.0
Ht. (inches)																													
41	60.3																												
42	61.8	60.9	60.0																										
43	63.2	62.3	61.4	60.6																									
44	64.7	63.8	62.9	62.1	61.3	60.4																							
45	66.2	65.2	64.3	63.5	62.7	61.8	61.0	60.2																					
46	67.6	66.7	65.7	64.9	64.1	63.2	62.3	61.6	60.8	60.1																			
47	69.1	68.1	67.1	66.3	65.5	64.6	63.7	62.9	62.2	61.4	60.8	60.3																	
48	70.6	69.6	68.6	67.7	66.9	65.9	65.0	64.3	63.5	62.7	62.1	61.6	61.1	60.5	60.0														
49	72.1	71.0	70.0	69.1	68.3	67.3	66.4	65.6	64.8	64.1	63.4	62.9	62.3	61.7	61.3	60.7	60.3	60.0											
50	73.5	72.5	71.4	70.5	69.6	68.7	67.8	66.9	66.1	65.4	64.7	64.2	63.6	63.0	62.5	62.0	61.6	61.3	61.1	60.9	60.8	60.5	60.1						
51	75.0	73.9	72.9	71.9	71.0	70.1	69.1	68.3	67.5	66.7	66.0	65.5	64.9	64.2	63.8	63.2	62.8	62.5	62.3	62.1	62.0	61.7	61.3	60.8	60.4				
52	76.5	75.4	74.3	73.3	72.4	71.4	70.5	69.6	68.8	68.0	67.3	66.8	66.2	65.5	65.0	64.4	64.0	63.7	63.5	63.3	63.2	62.9	62.5	62.0	61.5	61.0	60.5		
53	77.9	76.8	75.7	74.8	73.8	72.8	71.8	71.0	70.1	69.3	68.6	68.0	67.4	66.8	66.3	65.7	65.3	65.0	64.7	64.6	64.4	64.1	63.7	63.2	62.7	62.2	61.6	61.0	60.2
54	79.4	78.3	77.1	76.2	75.2	74.2	73.2	72.3	71.4	70.6	69.9	69.3	68.7	68.0	67.5	66.9	66.5	66.2	65.9	65.8	65.6	65.3	64.9	64.4	63.9	63.4	62.8	62.1	61.4
55	80.9	79.7	78.6	77.6	76.6	75.5	74.5	73.6	72.8	71.9	71.2	70.6	70.0	69.3	68.8	68.2	67.7	67.4	67.2	67.0	66.8	66.5	66.1	65.6	65.1	64.6	64.0	63.3	62.5
56			80.0	79.0	78.0	76.9	75.9	75.0	74.1	73.2	72.4	71.9	71.2	70.5	70.0	69.4	69.0	68.6	68.4	68.2	68.0	67.7	67.3	66.7	66.3	65.7	65.1	64.4	63.6
57				80.4	79.4	78.3	77.2	76.3	75.4	74.5	73.7	73.2	72.5	71.8	71.3	70.6	70.2	69.9	69.6	69.4	69.3	68.9	68.5	67.9	67.5	66.9	66.3	65.6	64.8
58					80.8	79.7	78.6	77.6	76.7	75.8	75.0	74.5	73.8	73.0	72.5	71.9	71.4	71.1	70.8	70.6	70.5	70.1	69.7	69.1	68.6	68.1	67.4	66.7	65.9
59							79.9	79.0	78.0	77.1	76.3	75.7	75.1	74.3	73.8	73.1	72.7	72.3	72.0	71.9	71.7	71.3	70.9	70.3	69.8	69.2	68.6	67.9	67.0
60								80.3	79.4	78.4	77.6	77.0	76.3	75.6	75.0	74.4	73.9	73.5	73.3	73.1	72.9	72.6	72.1	71.5	71.0	70.4	69.8	69.0	68.2
61									80.7	79.7	78.9	78.3	77.6	76.8	76.3	75.6	75.1	74.8	74.5	74.3	74.1	73.8	73.3	72.7	72.2	71.6	70.9	70.2	69.3
62											80.2	79.6	78.9	78.1	77.5	76.8	76.4	76.0	75.7	75.5	75.3	75.0	74.5	73.9	73.4	72.8	72.1	71.3	70.5
63												80.9	80.2	79.3	78.8	78.1	77.6	77.2	76.9	76.7	76.5	76.2	75.7	75.1	74.6	73.9	73.3	72.5	71.6
64														80.6	80.0	79.3	78.8	78.4	78.1	78.0	77.8	77.4	76.9	76.3	75.7	75.1	74.4	73.6	72.7
65																80.5	80.0	79.7	79.4	79.2	79.0	78.6	78.1	77.5	76.9	76.3	75.6	74.8	73.9
66																		80.9	80.6	80.4	80.2	79.8	79.3	78.7	78.1	77.5	76.7	75.9	75.0
67																							80.5	79.9	79.3	78.6	77.9	77.1	76.1

To take another example: A girl who is 12 years old has an SA of 10 years 3 months, and is 55 inches tall. Using Table IIIE, the intersection of the 10-3 column and the 55 inch row gives a probable mature height of 62.2 inches.

Predictions for ages younger than those given in the tables are subject to large errors. But it is sometimes desirable to make some prediction at an early age. Adult heights could then be estimated from the percentages given in Table I.

INTERPRETATION

The predictions from the tables are not perfectly accurate, even though after 9 years of age they are far better than estimates made on the basis of age without regard to maturational status. There are several sources of error which must be kept in mind when making any predictions.

(a) X-rays may be inaccurately read. Accuracy can be increased by practice in the use of the standards, but such assessments always remain approximations. It is, therefore, very desirable to reduce the error by making several independent readings (by the same or different persons) and then to take the average of these readings.

(b) These prediction tables were developed from the Greulich-Pyle standards for hands, with the expectation that they will be used in conjunction with these standards. They have not been tested for readings made from other areas of the skeleton, or other methods of assessing degree of skeletal maturing. Such usage might yield less accurate predictions.

(c) Also, there is some inaccuracy in measurements of height. Both diurnal variations in stature, and careless measuring techniques, could account for some of the error in prediction.

Aside from these technical factors, we must consider the variations in children's developmental processes. Patterns of growth may be influenced to some extent by illnesses, accidents, changes in diet, or certain hormone imbalances. For these reasons one must, in clinical practice, assess every prediction of future growth against the background of all available knowledge about the particular child and his own growth history.

In setting up the tables it has been necessary to take into consideration the differences in growth rates of accelerated and retarded children. In general, there is a relationship between the intensities of maturation and growth. Children who are accelerated in physical maturity tend to grow with exceptional vigor, and children who are retarded in their maturation tend to grow in a more subdued manner than the average. As a result, the accelerated child, though he has achieved a greater PMH than the average child his age, will have achieved less than the average for his skeletal age. Conversely, the retarded child, though behind his age peers, will be closer to his eventual height than the average for his degree of skeletal maturity. In other words, the younger the child for a given SA the more chance he has for further growth.

The supplementary tables take care of the differences in growth rate for the ages where the predictions will be affected. For example, at 10 years the average girl has completed 86.2 per cent of her eventual height; but the accelerated 8½-year-old with an SA of 10 years has completed 82.8 per cent, and the retarded 12-year-old with an SA of 10 years has achieved 87.4 per cent of her adult stature. The percentages for these deviant cases may be compared with the normal expectancy for their chronological ages: 81.0 per cent at 8½ and 92.2 per cent at 12. Even these supplementary tables may not be adequate for the more extreme deviates. The children who are retarded more than two years will probably reach shorter adult heights, and those who are accelerated more than two years are likely to become taller than the prediction tables indicate.

TABLE IIIA. AVERAGE GIRLS. PERCENTAGES AND ESTIMATED MATURE HEIGHTS FOR GIRLS WITH SKELETAL AGES WITHIN ONE YEAR OF THEIR CHRONOLOGICAL AGES:

SKELETAL AGES 6 THROUGH 11 YEARS

Skeletal Age	6-0	6-3	6-6	**6-10**	7-0	7-3	7-6	**7-10**	8-0	8-3	8-6	**8-10**	9-0	9-3	9-6	9-9	**10-0**	10-3	10-6	10-9	**11-0**	11-3	11-6	11-9
% of Mature Height	72.0	72.9	73.8	75.1	75.7	76.5	77.2	78.2	79.0	80.1	81.0	82.1	82.7	83.6	84.4	85.3	86.2	87.4	88.4	89.6	90.6	91.0	91.4	91.8
Ht. (inches)																								
37	51.4																							
38	52.8	52.1	51.5																					
39	54.2	53.5	52.8	52.0	51.5	51.0																		
40	55.6	54.9	54.2	53.3	52.8	52.3	51.8	51.2																
41	56.9	56.2	55.6	54.6	54.2	53.6	53.1	52.4	51.9	51.2														
42	58.3	57.6	56.9	55.9	55.5	54.9	54.4	53.7	53.2	52.4	51.9	51.2												
43	59.7	59.0	58.3	57.3	56.8	56.2	55.7	55.0	54.4	53.7	53.1	52.4	52.0	51.4										
44	61.1	60.4	59.6	58.6	58.1	57.5	57.0	56.3	55.7	54.9	54.3	53.6	53.2	52.6	52.1	51.6	51.0							
45	62.5	61.7	61.0	59.9	59.4	58.8	58.3	57.5	57.0	56.2	55.6	54.8	54.4	53.8	53.3	52.8	52.2	51.5						
46	63.9	63.1	62.3	61.3	60.8	60.1	59.6	58.8	58.2	57.4	56.8	56.0	55.6	55.0	54.5	53.9	53.4	52.6	52.0	51.3				
47	65.3	64.5	63.7	62.6	62.1	61.4	60.9	60.1	59.5	58.7	58.0	57.2	56.8	56.2	55.7	55.1	54.5	53.8	53.2	52.5	51.9	51.6	51.4	51.2
48	66.7	65.8	65.0	63.9	63.4	62.7	62.2	61.4	60.8	59.9	59.3	58.5	58.0	57.4	56.9	56.3	55.7	54.9	54.3	53.6	53.0	52.7	52.5	52.3
49	68.1	67.2	66.4	65.2	64.7	64.1	63.5	62.7	62.0	61.2	60.5	59.7	59.3	58.6	58.1	57.4	56.8	56.1	55.4	54.7	54.1	53.8	53.6	53.4
50	69.4	68.6	67.8	66.6	66.1	65.4	64.8	63.9	63.3	62.4	61.7	60.9	60.5	59.8	59.2	58.6	58.0	57.2	56.6	55.8	55.2	54.9	54.7	54.5
51	70.8	70.0	69.1	67.9	67.4	66.7	66.1	65.2	64.6	63.7	63.0	62.1	61.7	61.0	60.4	59.8	59.2	58.4	57.7	56.9	56.3	56.0	55.8	55.6
52	72.2	71.3	70.5	69.2	68.7	68.0	67.4	66.5	65.8	64.9	64.2	63.3	62.9	62.2	61.6	61.0	60.3	59.5	58.8	58.0	57.4	57.1	56.9	56.6
53	73.6	72.7	71.8	70.6	70.0	69.3	68.7	67.8	67.1	66.2	65.4	64.6	64.1	63.4	62.8	62.1	61.5	60.6	60.0	59.2	58.5	58.2	58.0	57.7
54		74.1	73.2	71.9	71.3	70.6	69.9	69.1	68.4	67.4	66.7	65.8	65.3	64.6	64.0	63.3	62.6	61.8	61.1	60.3	59.6	59.3	59.1	58.8
55			74.5	73.2	72.7	71.9	71.2	70.3	69.6	68.7	67.9	67.0	66.5	65.8	65.2	64.5	63.8	62.9	62.2	61.4	60.7	60.4	60.2	59.9
56				74.6	74.0	73.2	72.5	71.6	70.9	69.9	69.1	68.2	67.7	67.0	66.4	65.7	65.0	64.1	63.3	62.5	61.8	61.5	61.3	61.0
57						74.5	73.8	72.9	72.2	71.2	70.4	69.4	68.9	68.2	67.5	66.8	66.1	65.2	64.5	63.6	62.9	62.6	62.4	62.1
58								74.2	73.4	72.4	71.6	70.6	70.1	69.4	68.7	68.0	67.3	66.4	65.6	64.7	64.0	63.7	63.5	63.2
59									74.7	73.7	72.8	71.9	71.3	70.6	69.9	69.2	68.4	67.5	66.7	65.8	65.1	64.8	64.6	64.3
60										74.9	74.1	73.1	72.6	71.8	71.1	70.3	69.6	68.7	67.9	67.0	66.2	65.9	65.6	65.4
61												74.3	73.8	73.0	72.3	71.5	70.8	69.8	69.0	68.1	67.3	67.0	66.7	66.4
62														74.2	73.5	72.7	71.9	70.9	70.1	69.2	68.4	68.1	67.8	67.5
63															74.6	73.9	73.1	72.1	71.3	70.3	69.5	69.2	68.9	68.6
64																	74.2	73.2	72.4	71.4	70.6	70.3	70.0	69.7
65																		74.4	73.5	72.5	71.7	71.4	71.1	70.8
66																			74.7	73.7	72.9	72.5	72.2	71.9
67																				74.8	74.0	73.6	73.3	73.0
68																						74.7	74.4	74.1

Table IIIB. AVERAGE GIRLS. Percentages and Estimated Mature Heights for Girls With Skeletal Ages Within One Year of Their Chronological Ages:

Skeletal Ages 12 Through 18 Years

Skeletal Age	**12-0**	12-3	12-6	12-9	**13-0**	13-3	**13-6**	13-9	**14-0**	14-3	14-6	14-9	**15-0**	15-3	15-6	15-9	**16-0**	16-3	16-6	16-9	**17-0**	17-6	**18-0**
% of Mature Height	92.2	93.2	94.1	95.0	95.8	96.7	97.4	97.8	98.0	98.3	98.6	98.8	99.0	99.1	99.3	99.4	99.6	99.6	99.7	99.8	99.9	99.95	100.0
Ht. (inches)																							
47	51.0																						
48	52.1	51.5	51.0																				
49	53.1	52.6	52.1	51.6	51.1																		
50	54.2	53.6	53.1	52.6	52.2	51.7	51.3	51.1	51.0														
51	55.3	54.7	54.2	53.7	53,2	52.7	52.4	52.1	52.0	51.9	51.7	51.6	51.5	51.5	51.4	51.3	51.2	51.2	51.2	51.1	51.1	51.0	51.0
52	56.4	55.8	55.3	54.7	54.3	53.8	53.4	53.2	53.1	52.9	52.7	52.6	52.5	52.5	52.4	52.3	52.2	52.2	52.2	52.1	52.1	52.0	52.0
53	57.5	56.9	56.3	55.8	55.3	54.8	54.4	54.2	54.1	53.9	53.8	53.6	53.5	53.5	53.4	53.3	53.2	53.2	53.2	53.1	53.1	53.0	53.0
54	58.6	57.9	57.4	56.8	56.4	55.8	55.4	55.2	55.1	54.9	54.8	54.7	54.5	54.5	54.4	54.3	54.2	54.2	54.2	54.1	54.1	54.0	54.0
55	59.7	59.0	58.4	57.9	57.4	56.9	56.5	56.2	56.1	56.0	55.8	55.7	55.6	55.5	55.4	55.3	55.2	55.2	55.2	55.1	55.1	55.0	55.0
56	60.7	60.1	59.5	58.9	58.5	57.9	57.5	57.3	57.1	57.0	56.8	56.7	56.6	56.5	56.4	56.3	56.2	56.2	56.2	56.1	56.1	56.0	56.0
57	61.8	61.2	60.6	60.0	59.5	58.9	58.5	58.3	58.2	58.0	57.8	57.7	57.6	57.5	57.4	57.3	57.2	57.2	57.2	57.1	57.1	57.0	57.0
58	62.9	62.2	61.6	61.1	60.5	60.0	59.5	59.3	59.2	59.0	58.8	58.7	58.6	58.5	58.4	58.3	58.2	58.2	58.2	58.1	58.1	58.0	58.0
59	64.0	63.3	62.7	62.1	61.6	61.0	60.6	60.3	60.2	60.0	59.8	59.7	59.6	59.5	59.4	59.4	59.2	59.2	59.2	59.1	59.1	59.0	59.0
60	65.1	64.4	63.8	63.2	62.6	62.0	61.6	61.3	61.2	61.0	60.9	60.7	60.6	60.5	60.4	60.4	60.2	60.2	60.2	60.1	60.1	60.0	60.0
61	66.2	65.5	64.8	64.2	63.7	63.1	62.6	62.4	62.2	62.1	61.9	61.7	61.6	61.6	61.4	61.4	61.2	61.2	61.2	61.1	61.1	61.0	61.0
62	67.2	66.5	65.9	65.3	64.7	64.1	63.7	63.4	63.3	63.1	62.9	62.8	62.6	62.6	62.4	62.4	62.2	62.2	62.2	62.1	62.1	62.0	62.0
63	68.3	67.6	67.0	66.3	65.8	65.1	64.7	64.4	64.3	64.1	63.9	63.8	63.6	63.6	63.4	63.4	63.3	63.3	63.2	63.1	63.1	63.0	63.0
64	69.4	68.7	68.0	67.4	66.8	66.2	65.7	65.4	65.3	65.1	64.9	64.8	64.6	64.6	64.4	64.4	64.3	64.3	64.2	64.1	64.1	64.0	64.0
65	70.5	69.7	69.1	68.4	67.8	67.2	66.7	66.5	66.3	66.1	65.9	65.8	65.7	65.6	65.5	65.4	65.3	65.3	65.2	65.1	65.1	65.0	65.0
66	71.6	70.8	70.1	69.5	68.9	68.3	67.8	67.5	67.3	67.1	66.9	66.8	66.7	66.6	66.5	66.4	66.3	66.3	66.2	66.1	66.1	66.0	66.0
67	72.7	71.9	71.2	70.5	69.9	69.3	68.8	68.5	68.4	68.2	68.0	67.8	67.7	67.6	67.5	67.4	67.3	67.3	67.2	67.1	67.1	67.0	67.0
68	73.8	73.0	72.3	71.6	71.0	70.3	69.8	69.5	69.4	69.2	69.0	68.8	68.7	68.6	68.5	68.4	68.3	68.3	68.2	68.1	68.1	68.0	68.0
69	74.8	74.0	73.3	72.6	72.0	71.4	70.8	70.6	70.4	70.2	70.0	69.8	69.7	69.6	69.5	69.4	69.3	69.3	69.2	69.1	69.1	69.0	69.0
70			74.4	73.7	73.1	72.4	71.9	71.6	71.4	71.2	71.0	70.8	70.7	70.6	70.5	70.4	70.3	70.3	70.2	70.1	70.1	70.0	70.0
71				74.7	74.1	73.4	72.9	72.6	72.4	72.2	72.0	71.9	71.7	71.6	71.5	71.4	71.3	71.3	71.2	71.1	71.1	71.0	71.0
72						74.5	73.9	73.6	73.5	73.2	73.0	72.9	72.7	72.7	72.5	72.4	72.3	72.3	72.2	72.1	72.1	72.0	72.0
73							74.9	74.6	74.5	74.3	74.0	73.9	73.7	73.7	73.5	73.4	73.3	73.3	73.2	73.1	73.1	73.0	73.0
74												74.9	74.7	74.7	74.5	74.4	74.3	74.3	74.2	74.1	74.1	74.0	74.0

TABLE IIIC. ACCELERATED GIRLS. PERCENTAGES AND ESTIMATED MATURE HEIGHTS FOR GIRLS WITH SKELETAL AGES ONE YEAR OR MORE ADVANCED OVER THEIR CHRONOLOGICAL AGES:

SKELETAL AGES 7 THROUGH 11 YEARS

Skeletal Age	7-0	7-3	7-6	7-10	8-0	8-3	8-6	8-10	9-0	9-3	9-6	9-9	10-0	10-3	10-6	10-9	11-0	11-3	11-6	11-9
% of Mature Height	71.2	72.2	73.2	74.2	75.0	76.0	77.1	78.4	79.0	80.0	80.9	81.9	82.8	84.1	85.6	87.0	88.3	88.7	89.1	89.7
Ht. (inches)																				
37	52.0	51.2																		
38	53.4	52.6	51.9	51.2																
39	54.8	54.0	53.3	52.6	52.0	51.3														
40	56.2	55.4	54.6	53.9	53.3	52.6	51.9	51.0												
41	57.6	56.8	56.0	55.3	54.7	53.9	53.2	52.3	51.9	51.3										
42	59.0	58.2	57.4	56.6	56.0	55.3	54.5	53.6	53.2	52.5	51.9	51.3								
43	60.4	59.6	58.7	58.0	57.3	56.6	55.8	54.8	54.4	53.8	53.2	52.5	51.9	51.1						
44	61.8	60.9	60.1	59.3	58.7	57.9	57.1	56.1	55.7	55.0	54.4	53.7	53.1	52.3	51.4					
45	63.2	62.3	61.5	60.6	60.0	59.2	58.4	57.4	57.0	56.3	55.6	54.9	54.3	53.5	52.6	51.7	51.0			
46	64.6	63.7	62.8	62.0	61.3	60.5	59.7	58.7	58.2	57.5	56.9	56.2	55.6	54.7	53.7	52.9	52.1	51.9	51.6	51.3
47	66.0	65.1	64.2	63.3	62.7	61.8	61.0	59.9	59.5	58.8	58.1	57.4	56.8	55.9	54.9	54.0	53.2	53.0	52.7	52.4
48	67.4	66.5	65.6	64.7	64.0	63.2	62.3	61.2	60.8	60.0	59.3	58.6	58.0	57.1	56.1	55.2	54.4	54.1	53.9	53.5
49	68.8	67.9	66.9	66.0	65.3	64.5	63.6	62.5	62.0	61.3	60.6	59.8	59.2	58.3	57.2	56.3	55.5	55.2	55.0	54.6
50	70.2	69.3	68.3	67.4	66.7	65.8	64.9	63.8	63.3	62.5	61.8	61.1	60.4	59.5	58.4	57.5	56.6	56.4	56.1	55.7
51	71.6	70.6	69.7	68.7	68.0	67.1	66.1	65.1	64.6	63.8	63.0	62.3	61.6	60.6	59.6	58.6	57.8	57.5	57.2	56.9
52	73.0	72.0	71.0	70.1	69.3	68.4	67.4	66.3	65.8	65.0	64.3	63.5	62.8	61.8	60.7	59.8	58.9	58.6	58.4	58.0
53	74.4	73.4	72.4	71.4	70.7	69.7	68.7	67.6	67.1	66.3	65.5	64.7	64.0	63.0	61.9	60.9	60.0	59.8	59.5	59.1
54		74.8	73.8	72.8	72.0	71.1	70.0	68.9	68.4	67.5	66.7	65.9	65.2	64.2	63.1	62.1	61.2	60.9	60.6	60.2
55				74.1	73.3	72.4	71.3	70.2	69.6	68.8	68.0	67.2	66.4	65.4	64.3	63.2	62.3	62.0	61.7	61.3
56					74.7	73.7	72.6	71.4	70.9	70.0	69.2	68.4	67.6	66.6	65.4	64.4	63.4	63.1	62.8	62.4
57							73.9	72.7	72.2	71.3	70.5	69.6	68.8	67.8	66.6	65.5	64.6	64.3	64.0	63.5
58								74.0	73.4	72.5	71.7	70.8	70.0	69.0	67.8	66.7	65.7	65.4	65.1	64.7
59									74.7	73.8	72.9	72.0	71.3	70.2	68.9	67.8	66.8	66.5	66.2	65.8
60											74.2	73.3	72.5	71.3	70.1	69.0	68.0	67.6	67.3	66.9
61												74.5	73.7	72.5	71.3	70.1	69.1	68.8	68.5	68.0
62													74.9	73.7	72.4	71.3	70.2	69.9	69.6	69.1
63														74.9	73.6	72.4	71.3	71.0	70.7	70.2
64															74.8	73.6	72.5	72.2	71.8	71.3
65																74.7	73.6	73.3	72.9	72.5
66																	74.7	74.4	74.1	73.6
67																				74.7

TABLE IIID. ACCELERATED GIRLS. PERCENTAGES AND ESTIMATED MATURE HEIGHTS FOR GIRLS WITH SKELETAL AGES ONE YEAR OR MORE ADVANCED OVER THEIR CHRONOLOGICAL AGES:

SKELETAL AGES 12 THROUGH 17 YEARS

Skeletal Age	**12-0**	12-3	12-6	12-9	**13-0**	13-3	13-6	13-9	**14-0**	14-3	14-6	14-9	**15-0**	15-3	15-6	15-9	**16-0**	16-3	16-6	16-9	**17-0**	17-6
% of Mature Height	90.1	91.3	92.4	93.5	94.5	95.5	96.3	96.8	97.2	97.7	98.0	98.3	98.6	98.8	99.0	99.2	99.3	99.4	99.5	99.7	99.8	99.95
Ht. (inches)																						
46	51.1																					
47	52.2	51.5																				
48	53.3	52.6	51.9	51.3																		
49	54.4	53.7	53.0	52.4	51.9	51.3	50.9															
50	55.5	54.8	54.1	53.5	52.9	52.4	51.9	51.7	51.4	51.2	51.0											
51	56.6	55.9	55.2	54.5	54.0	53.4	53.0	52.7	52.5	52.2	52.0	51.9	51.7	51.6	51.5	51.4	51.4	51.3	51.3	51.2	51.1	51.0
52	57.7	57.0	56.3	55.6	55.0	54.5	54.0	53.7	53.5	53.2	53.1	52.9	52.7	52.6	52.5	52.4	52.4	52.3	52.3	52.2	52.1	52.0
53	58.8	58.1	57.4	56.7	56.1	55.5	55.0	54.8	54.5	54.2	54.1	53.9	53.8	53.6	53.5	53.4	53.4	53.3	53.3	53.2	53.1	53.0
54	59.9	59.1	58.4	57.8	57.1	56.5	56.1	55.8	55.6	55.3	55.1	54.9	54.8	54.7	54.5	54.4	54.4	54.3	54.3	54.2	54.1	54.0
55	61.0	60.2	59.5	58.8	58.2	57.6	57.1	56.8	56.6	56.3	56.1	56.0	55.8	55.7	55.5	55.4	55.4	55.3	55.3	55.2	55.1	55.0
56	62.2	61.3	60.6	59.9	59.3	58.6	58.2	57.9	57.6	57.3	57.1	57.0	56.8	56.7	56.5	56.5	56.4	56.3	56.3	56.2	56.1	56.0
57	63.3	62.4	61.7	61.0	60.3	59.7	59.2	58.9	58.6	58.3	58.2	58.0	57.8	57.7	57.6	57.5	57.4	57.3	57.3	57.2	57.1	57.0
58	64.4	63.5	62.8	62.0	61.4	60.7	60.2	59.9	59.7	59.4	59.2	59.0	58.8	58.7	58.6	58.5	58.4	58.3	58.3	58.2	58.1	58.0
59	65.5	64.6	63.9	63.1	62.4	61.8	61.3	61.0	60.7	60.4	60.2	60.0	59.8	59.7	59.6	59.5	59.4	59.4	59.3	59.2	59.1	59.0
60	66.6	65.7	64.9	64.2	63.5	62.8	62.3	62.0	61.7	61.4	61.2	61.0	60.9	60.7	60.6	60.5	60.4	60.4	60.3	60.2	60.1	60.0
61	67.7	66.8	66.0	65.2	64.6	63.9	63.3	63.0	62.8	62.4	62.2	62.1	61.9	61.7	61.6	61.5	61.4	61.4	61.3	61.2	61.1	61.0
62	68.8	67.9	67.1	66.3	65.6	64.9	64.4	64.0	63.8	63.5	63.3	63.1	62.9	62.8	62.6	62.5	62.4	62.4	62.3	62.2	62.1	62.0
63	69.9	69.0	68.2	67.4	66.7	66.0	65.4	65.1	64.8	64.5	64.3	64.1	63.9	63.8	63.6	63.5	63.4	63.4	63.3	63.2	63.1	63.0
64	71.0	70.1	69.3	68.4	67.7	67.0	66.5	66.1	65.8	65.5	65.3	65.1	64.9	64.8	64.6	64.5	64.4	64.4	64.3	64.2	64.1	64.0
65	72.1	71.2	70.3	69.5	68.8	68.1	67.5	67.1	66.9	66.5	66.3	66.1	65.9	65.8	65.7	65.5	65.5	65.4	65.3	65.2	65.1	65.0
66	73.3	72.3	71.4	70.6	69.8	69.1	68.5	68.2	67.9	67.6	67.3	67.1	66.9	66.8	66.7	66.5	66.5	66.4	66.3	66.2	66.1	66.0
67	74.4	73.4	72.5	71.7	70.9	70.2	69.6	69.2	68.9	68.6	68.4	68.2	68.0	67.8	67.7	67.5	67.5	67.4	67.3	67.2	67.1	67.0
68		74.5	73.6	72.7	72.0	71.2	70.6	70.2	70.0	69.6	69.4	69.2	69.0	68.8	68.7	68.6	68.5	68.4	68.3	68.2	68.1	68.0
69			74.7	73.8	73.0	72.3	71.7	71.3	71.0	70.6	70.4	70.2	70.0	69.8	69.7	69.6	69.5	69.4	69.3	69.2	69.1	69.0
70				74.9	74.1	73.3	72.7	72.3	72.0	71.6	71.4	71.2	71.0	70.8	70.7	70.6	70.5	70.4	70.3	70.2	70.1	70.0
71						74.3	73.7	73.3	73.0	72.7	72.4	72.2	72.0	71.9	71.7	71.6	71.5	71.4	71.4	71.2	71.1	71.0
72							74.8	74.4	74.1	73.7	73.5	73.2	73.0	72.9	72.7	72.6	72.5	72.4	72.4	72.2	72.1	72.0
73										74.7	74.5	74.3	74.0	73.9	73.7	73.6	73.5	73.4	73.4	73.2	73.1	73.0
74														74.9	74.4	74.6	74.5	74.4	74.4	74.2	74.1	74.0

TABLE IIIE. RETARDED GIRLS. PERCENTAGES AND ESTIMATED MATURE HEIGHTS FOR GIRLS WITH SKELETAL AGES ONE YEAR OR MORE RETARDED FOR THEIR CHRONOLOGICAL AGES:

SKELETAL AGES 6 THROUGH 11 YEARS

Skeletal Age	6-0	6-3	6-6	**6-10**	7-0	7-3	7-6	**7-10**	8-0	8-3	8-6	**8-10**	9-0	9-3	9-6	9-9	**10-0**	10-3	10-6	10-9	**11-0**	11-3	11-6	11-9
% of Mature Height	73.3	74.2	75.1	76.3	77.0	77.9	78.8	79.7	80.4	81.3	82.3	83.6	84.1	85.1	85.8	86.6	87.4	88.4	89.6	90.7	91.8	92.2	92.6	92.9
Ht. (inches)																								
38	51.8	51.2																						
39	53.2	52.6	51.9	51.1																				
40	54.6	53.9	53.3	52.4	51.9	51.3																		
41	55.9	55.3	54.6	53.7	53.2	52.6	52.0	51.4																
42	57.3	56.6	55.9	55.0	54.5	53.9	53.3	52.7	52.2	51.7	51.0													
43	58.7	58.0	57.3	56.4	55.8	55.2	54.6	54.0	53.5	52.9	52.2	51.4	51.1											
44	60.0	59.3	58.6	57.7	57.1	56.5	55.8	55.2	54.7	54.1	53.5	52.6	52.3	51.7	51.3									
45	61.4	60.6	59.9	59.0	58.4	57.8	57.1	56.5	56.0	55.4	54.7	53.8	53.5	52.9	52.4	52.0	51.5							
46	62.8	62.0	61.3	60.3	59.7	59.1	58.4	57.7	57.2	56.6	55.9	55.0	54.7	54.1	53.6	53.1	52.6	52.0	51.3					
47	64.1	63.3	62.6	61.6	61.0	60.3	59.6	59.0	58.5	57.8	57.1	56.2	55.9	55.2	54.8	54.3	53.8	53.2	52.5	51.8	51.2	51.0		
48	65.5	64.7	63.9	62.9	62.3	61.6	60.9	60.2	59.7	59.0	58.3	57.4	57.1	56.4	55.9	55.4	54.9	54.3	63.6	52.9	52.3	52.1	51.8	51.7
49	66.9	66.0	65.2	64.2	63.6	62.9	62.2	61.5	60.9	60.3	59.5	58.6	58.3	57.6	57.1	56.6	56.1	55.4	54.7	54.0	53.4	53.1	52.9	52.7
50	68.2	67.4	66.6	65.5	64.9	64.2	63.5	62.7	62.2	61.5	60.8	59.8	59.5	58.8	58.3	57.7	57.2	56.6	55.8	55.1	54.5	54.2	54.0	53.8
51	69.6	68.7	67.9	66.8	66.2	65.5	64.7	64.0	63.4	62.7	62.0	61.0	60.6	59.9	59.4	58.9	58.4	57.7	56.9	56.2	55.6	55.3	55.1	54.9
52	70.9	70.1	69.2	68.2	67.5	66.8	66.0	65.2	64.7	64.0	63.2	62.2	61.8	61.1	60.6	60.0	59.5	58.8	58.0	57.3	56.6	56.4	56.2	56.0
53	72.3	71.4	70.6	69.5	68.8	68.0	67.3	66.5	65.9	65.2	64.4	63.4	63.0	62.3	61.8	61.2	60.6	60.0	59.2	58.4	57.7	57.5	57.2	57.1
54	73.7	72.8	71.9	70.8	70.1	69.3	68.5	67.8	67.2	66.4	65.6	64.6	64.2	63.5	62.9	62.4	61.8	61.1	60.3	59.5	58.8	58.6	58.3	58.1
55		74.1	73.2	72.1	71.4	70.6	69.8	69.0	68.4	67.7	66.8	65.8	65.4	64.6	64.1	63.5	62.9	62.2	61.4	60.6	59.9	59.7	59.4	59.2
56			74.6	73.4	72.7	71.9	71.1	70.3	69.7	68.9	68.0	67.0	66.6	65.8	65.3	64.7	64.1	63.3	62.5	61.7	61.0	60.7	60.5	60.3
57				74.7	74.0	73.2	72.3	71.5	70.9	70.1	69.3	68.2	67.8	67.0	66.4	65.8	65.2	64.5	63.6	62.8	62.1	61.8	61.6	61.4
58						74.5	73.6	72.8	72.1	71.3	70.5	69.4	69.0	68.2	67.6	67.0	66.4	65.6	64.7	63.9	63.2	62.9	62.6	62.4
59							74.9	74.0	73.4	72.6	71.7	70.6	70.2	69.3	68.8	68.1	67.5	66.7	65.8	65.0	64.3	64.0	63.7	63.5
60									74.6	73.8	72.9	71.8	71.3	70.5	69.9	69.3	68.7	67.9	67.0	66.2	65.4	65.1	64.8	64.6
61											74.1	73.0	72.5	71.7	71.1	70.4	69.8	69.0	68.1	67.3	66.4	66.2	65.9	65.7
62												74.2	73.7	72.9	72.3	71.6	70.9	70.1	69.2	68.4	67.5	67.2	67.0	66.7
63													74.7	74.0	73.4	72.7	72.1	71.3	70.3	69.5	68.6	68.3	68.0	67.8
64															74.6	73.9	73.2	72.4	71.4	70.6	69.7	69.4	69.1	68.9
65																	74.4	73.5	72.5	71.7	70.8	70.5	70.2	70.0
66																		74.7	73.7	72.8	71.9	71.6	71.3	71.0
67																			74.8	73.9	73.0	72.7	72.4	72.1
68																					74.1	73.8	73.4	73.2
69																						74.8	74.5	74.3

TABLE IIIF. RETARDED GIRLS. PERCENTAGES AND ESTIMATED MATURE HEIGHTS FOR GIRLS WITH SKELETAL AGES ONE YEAR OR MORE RETARDED FOR THEIR CHRONOLOGICAL AGES:

SKELETAL AGES 12 THROUGH 17 YEARS

Skeletal Age	**12-0**	12-3	12-6	12-9	**13-0**	13-3	**13-6**	13-9	**14-0**	14-3	14-6	14-9	**15-0**	15-3	15-6	15-9	**16-0**	16-3	16-6	16-9	**17-0**
% of Mature Height	93.2	94.2	94.9	95.7	96.4	97.1	97.7	98.1	98.3	98.6	98.9	99.2	99.4	99.5	99.6	99.7	99.8	99.9	99.9	99.95	100.0
Ht. (inches)																					
48	51.5	51.0																			
49	52.6	52.0	51.6	51.2																	
50	53.6	53.1	52.7	52.2	51.9	51.5	51.2	51.0													
51	54.7	54.1	53.7	53.3	52.9	52.5	52.2	52.0	51.9	51.7	51.6	51.4	51.3	51.3	51.2	51.2	51.1	51.1	51.1	51.0	51.0
52	55.8	55.2	54.8	54.3	53.9	53.6	53.2	53.0	52.9	52.7	52.6	52.4	52.3	52.3	52.2	52.2	52.1	52.1	52.1	52.0	52.0
53	56.9	56.3	55.8	55.4	55.0	54.6	54.2	54.0	53.9	53.8	53.6	53.4	53.3	53.3	53.2	53.2	53.1	53.1	53.1	53.0	53.0
54	57.9	57.3	56.9	56.4	56.0	55.6	55.3	55.0	54.9	54.8	54.6	54.4	54.3	54.3	54.2	54.2	54.1	54.1	54.1	54.0	54.0
55	59.0	58.4	58.0	57.5	57.1	56.6	56.3	56.1	56.0	55.8	55.6	55.4	55.3	55.3	55.2	55.2	55.1	55.1	55.1	55.0	55.0
56	60.1	59.4	59.0	58.5	58.1	57.7	57.3	57.1	57.0	56.8	56.6	56.5	56.3	56.3	56.2	56.2	56.1	56.1	56.1	56.0	56.0
57	61.2	60.5	60.1	59.6	59.1	58.7	58.3	58.1	58.0	57.8	57.6	57.5	57.3	57.3	57.2	57.2	57.1	57.1	57.1	57.0	57.0
58	62.2	61.6	61.1	60.6	60.2	59.7	59.4	59.1	59.0	58.8	58.6	58.5	58.3	58.3	58.2	58.2	58.1	58.1	58.1	58.0	58.0
59	63.3	62.6	62.2	61.7	61.2	60.8	60.4	60.1	60.0	59.8	59.7	59.5	59.4	59.3	59.2	59.2	59.1	59.1	59.1	59.0	59.0
60	64.4	63.7	63.2	62.7	62.2	61.8	61.4	61.2	61.0	60.9	60.7	60.5	60.4	60.3	60.2	60.2	60.1	60.1	60.1	60.0	60.0
61	65.5	64.8	64.3	63.7	63.3	62.8	62.4	62.2	62.1	61.9	61.7	61.5	61.4	61.3	61.2	61.2	61.1	61.1	61.1	61.0	61.0
62	66.5	65.8	65.3	64.8	64.3	63.9	63.5	63.2	63.1	62.9	62.7	62.5	62.4	62.3	62.2	62.2	62.1	62.1	62.1	62.0	62.0
63	67.6	66.9	66.4	65.8	65.3	64.9	64.5	64.2	64.1	63.9	63.7	63.5	63.4	63.3	63.3	63.2	63.1	63.1	63.1	63.0	63.0
64	68.7	67.9	67.4	66.9	66.4	65.9	65.5	65.2	65.1	64.9	64.7	64.5	64.4	64.3	64.3	64.2	64.1	64.1	64.1	64.0	64.0
65	69.7	69.0	68.5	67.9	67.4	66.9	66.5	66.3	66.1	65.9	65.7	65.5	65.4	65.3	65.3	65.2	65.1	65.1	65.1	65.0	65.0
66	70.8	70.1	69.5	69.0	68.5	68.0	67.6	67.3	67.1	66.9	66.7	66.5	66.4	66.3	66.3	66.2	66.1	66.1	66.1	66.0	66.0
67	71.9	71.1	70.6	70.0	69.5	69.0	68.6	68.3	68.2	68.0	67.7	67.5	67.4	67.3	67.3	67.2	67.1	67.1	67.1	67.0	67.0
68	73.0	72.2	71.7	71.1	70.5	70.0	69.6	69.3	69.2	69.0	68.8	68.6	68.4	68.3	68.3	68.2	68.1	68.1	68.1	68.0	68.0
69	74.0	73.2	72.7	72.1	71.6	71.1	70.6	70.3	70.2	70.0	69.8	69.6	69.4	69.3	69.3	69.2	69.1	69.1	69.1	69.0	69.0
70		74.3	73.8	73.1	72.6	72.1	71.6	71.4	71.2	71.0	70.8	70.6	70.4	70.4	70.3	70.2	70.1	70.1	70.1	70.0	70.0
71			74.8	74.2	73.6	73.1	72.7	72.4	72.2	72.0	71.8	71.6	71.4	71.4	71.3	71.2	71.1	71.1	71.1	71.0	71.0
72					74.7	74.2	73.7	73.4	73.3	73.0	72.8	72.6	72.4	72.4	72.3	72.2	72.1	72.1	72.1	72.0	72.0
73							74.7	74.4	74.3	74.0	73.8	73.6	73.4	73.4	73.3	73.2	73.1	73.1	73.1	73.0	73.0
74											74.8	74.6	74.4	74.4	74.3	74.2	74.1	74.1	74.1	74.0	74.0

The need for supplementary tables is probably also related to the fact that the development of the skeleton is only one part of the process of physical maturation, and is not perfectly correlated with the other parts. Those children selected as most retarded (or advanced) in one area are likely to be somewhat nearer the average in the other areas. Therefore a fair proportion of the children selected as skeletally deviant can be expected to have a *general* physical maturity age which is nearer the norm than is their SA. Whatever the reason, we find as a matter of practice, that accuracy of prediction is increased by use of the supplementary tables.

In practice the accuracy of estimates on a given child can be greatly increased by taking repeated x-rays over a period of time. The *trends* of the child's growth can then be evaluated in the light of other knowledge about him.

News and Notes

American Association of Orthodontists

The next meeting of the American Association of Orthodontists will be held at the Baker Hotel, Dallas, Texas, April 26 to 30, 1953.

Prize Essay Contest, American Association of Orthodontists

Eligibility.—Any member of the American Association of Orthodontists; any person affiliated with a recognized institution in the field of dentistry as a teacher, researcher, undergraduate or graduate student shall be eligible to enter the competition.

Character of Essay.—Each essay submitted must represent an original investigation and contain some new significant material of value to the art or science of orthodontics.

Prize.—A cash prize of $500 is offered for the essay judged to be the winner. The committee, however, reserves the right to omit the award if in its judgment none of the entries is considered to be worthy. Honorable mention will be awarded to those authors taking second and third places. The first three papers will become the property of the American Association of Orthodontists and will be published. All other essays will be returned.

Specifications.—All essays must be typewritten on 8½ by 11 inch white paper, double-spaced with 1 inch margins, and composed in good English. Three copies of each paper, complete with illustrations, bibliography, tables, and charts must be submitted. The name and address of the author must not appear in the essay. For purposes of identification, the author's name, together with a brief biographical sketch which sets forth his or her dental and/or orthodontic training, present activity and status (practitioner, teacher, student, research worker, etc.), should be typed on a separate sheet of paper and enclosed in a sealed envelope. The envelope should carry the title of the essay.

Presentation.—The author of the winning essay will be invited to present it at the meeting of the American Association of Orthodontists to be held at the Baker Hotel, Dallas, Texas, April 26 to 30, 1953.

Judges.—The entries will be judged by the Research Committee of the American Association of Orthodontists.

Final Submission Date.—No essay will be considered for this competition unless received in triplicate at the following address on or before March 1, 1953: Dr. J. A. Salzmann, 654 Madison Ave., New York 21, N. Y.

ROBERT E. MOYERS, Chairman, Research Committee,
American Association of Orthodontists,
230 College St.,
Toronto 2 B, Canada.

American Board of Orthodontics

The next meeting of the American Board of Orthodontics will be held at the Baker Hotel, Dallas, Texas, April 22 to April 26, 1953. Orthodontists who desire to be certified by the Board may obtain application blanks from the secretary, Dr. C. Edward Martinek, 661 Fisher Bldg., Detroit 2, Mich. To be considered at the Dallas meeting, all applications must be filed before March 1, 1953.

Central Section of the American Association of Orthodontists

The Fifteenth Annual Session of the Central Section of the American Association of Orthodontists was held at Hotel Fontenelle, Omaha, Neb., Oct. 13 and 14, 1952.

Scientific Program

MONDAY, OCT. 13, 1952

Morning Session

Security for the Professional Man by Proper Management of the Financial Affairs and the Business Side of Practice. Mr. Harold F. Keister, Chicago, Ill.

Many changes, rising taxes and the decline in the purchasing power of the dollar, have altered our business and financial lives. There are four basic reasons why men save money. Professional men must recognize the risks involved and do everything in their power to plan for emergencies, disability, old age, and death. Careful and sound financial planning is absolutely essential to a happy and successful life and practice.

Case Reports. Dr. Walter Winter, Decatur, Ill.

Afternoon Session

Extraoral Force. Dr. Carl F. Bruggemen, Los Angeles, Calif.

The first portion of Dr. Bruggemen's paper will deal with some of the hazards of intermaxillary force. Two unsuccessful cases will be presented to illustrate that the removal of dental units failed to solve the problem of anchorage. The paper will also be concerned with headcap versus cervical force, headcap construction. An analysis will be made of forces produced by various adjustments of the face bow. A table clinic will contain a detailed explanation of the procedure of treatment of maxillary protraction in the mixed and permanent dentitions.

Oral Pathology and Congenital Defects of the Child Patient. Dr. Gordon H. Rovelstad, Elgin, Ill.

At the present time Dr. Rovelstad enjoys a part-time association with the Children's Memorial Hospital in Chicago, in addition to being associated with his father in Elgin, Ill. A review of some of the conditions associated with orthodontic problems is most desirable.

Scientific Program

TUESDAY, OCTOBER 14, 1952

Morning Session

The Oliver Guide Plane, Early Changes in Tooth Position. Dr. William S. Brandhorst, St. Louis, Mo.

Cephalometric radiographs of tooth position and growth may be measured. Serial picture studies of many cases give information bearing upon the direction of tooth movement, changes occurring in the temporomandibular joint, and factors of growth, particularly in the mandible. Significance of these findings in relation to treatment methods and to the concept of centric occlusion in young individuals will also be discussed.

The Influence of Growth on Orthodontic Treatment. Robert W. Donavan, Chicago, Ill.

Cervical Gear Treatment—Indications, Contraindications, and Results. T. M. Graber, Chicago, Ill.

Drs. Donavan and Graber are associated with the Graduate Department of Orthodontics, Northwestern University Dental School. Both men are also engaged in the practice of orthodontics and are well qualified to speak on the subjects they have selected.

Afternoon Session

Clinics

1. Why Cephalometrics?	Raymond C. Thurow, Madison, Wis.
2. Cephalometric Examination of Headcap Treatment.	Donald H. Ketterhagen, Milwaukee, Wis.
3. Study Models of a Child From 2½ to 15½ Years of Age.	Frank J. Throm, Kansas City, Mo.
4. Time Savers for the Orthodontist.	Kenneth E. Holland, Lincoln, Neb.
5. Control Methods for Habits.	David J. Thompson, Elmhurst, Ill.
6. Case Presentation.	George B. Vogelei, Freeport, Ill.
7. Lingual Tipping of Incisal Edges With the Twin Wire Appliance.	Howard Yost, Grand Island, Neb.
8. Wetzel Grid Charts for Evaluating the Fitness in Terms of Physique Developmental Level and Basal Metabolism of the Orthodontic Patient.	Dorothy Denzler, Grand Island, Neb.
9. Space Obtainers—Unsoldered Spring Wire to Open Lost Spaces Due to Extractions.	William E. Stroft, Omaha, Neb.
10. Modified Johnson Treatment and Post-Treatment Appliances.	Earl E. Shepard, St. Louis, Mo., and Leo B. Lundergan, St. Louis, Mo.
11. Final Rotation Control of Lower Anterior Teeth.	William S. Brandhorst, St. Louis, Mo.

OFFICERS—1951-1952

President

Paul G. Ludwick — Lincoln, Neb.

President-elect

G. Hewett Williams — Chicago, Ill.

Vice-President

Earl E. Shepard — St. Louis, Mo.

Secretary-Treasurer

Frederick B. Lehman — Cedar Rapids, Iowa

Representative to A.A.O. Board of Directors

Cecil G. Muller — Omaha, Neb.

Alternate

S. J. Kloehn — Appleton, Wis.

Sectional Editor, American Journal of Orthodontics

Charles R. Baker — Evanston, Ill.

Southwestern Society of Orthodontists

The Thirty-second Annual Session of the Southwestern Society of Orthodontists was held Sunday, Monday, Tuesday, and Wednesday, Oct. 26, 27, 28, and 29, 1952, at the Gunter Hotel, San Antonio, Texas.

The Founding of the Southwestern Society of Orthodontists

The Southwestern Society of Orthodontists was founded at Dallas, Texas, in 1920. At the suggestion of Dr. T. O. Gorman and Dr. T. G. Duckworth, of San Antonio, the following men met at the Adolphus Hotel to organize the Southwestern Society: Dr. E. B. Arnold, Houston; Dr. O. E. Busby, Dallas; Dr. W. T. Chapman, El Paso; Dr. A. B. Conly, Dallas; Dr. T. G. Duckworth, San Antonio; Dr. T. O. Gorman, San Antonio; Dr. C. M. McCauley, Dallas; Dr. P. G. Spencer, Waco.

The Society was formed with Dr. T. O. Gorman, President, and Dr. W. T. Chapman, Secretary-Treasurer.

It was voted to hold the first annual meeting at the time of the Texas State Dental Society meeting in Dallas in 1921.

Dr. T. G. Duckworth was program chairman and arranged for Dr. Albert H. Ketcham to appear as the first guest clinician.

Scientific Program

Monday, Oct. 27, 1952

Diagnosis. L. B. Higley, D.D.S., Iowa City, Iowa.

Chairman: John W. Richmond, D.D.S., Kansas City, Kan.

Luncheon (Members and Guests), South Terrace, Gunter Hotel. Brooks Bell, D.D.S., President of the American Association of Orthodontists, "Your American Association."

Case Report.—Marcus D. Murphey, D.D.S., Houston, Tex.

Functional Adaptation of Bone. J. P. Weinmann, M.D., Chicago, Ill.

Chairman: Hugh A. Sims, D.D.S., Tulsa, Okla.

Tuesday, Oct. 28, 1952

Orientation Breakfast, Texas Room, Gunter Hotel.

Factors of Bone Resorption. J. P. Weinmann, M.D., Chicago, Ill. Chairman: Hugh A. Sims, D.D.S., Tulsa, Okla.

Diagnosis. L. B. Higley, D.D.S., Iowa City, Iowa. Chairman: John W. Richmond, D.D.S., Kansas City, Kan.

Selective Grinding—an Integral Part of Orthodontic Therapy. A. C. Heimlich, D.D.S., Santa Barbara, Calif. Chairman: Wm. N. Flesher, D.D.S., Oklahoma City, Okla.

General Clinics.

Wednesday, Oct. 29, 1952

Orthodontic Teaching at the Graduate Level. L. B. Higley, D.D.S., Iowa City, Iowa. Chairman: John W. Richmond, D.D.S., Kansas City, Kan.

Selective Grinding. Demonstration Period. A. C. Heimlich, D.D.S., Santa Barbara, Calif. Chairman: Wm. N. Flesher, D.D.S., Oklahoma City, Okla.

General Clinics

Arthur Bostick, D.D.S., Chairman

Tuesday, Oct. 28, 3:30 P.M.

1. Orthodontics in the Air Force. Colonel George F. Bowden, Captain Wade H. Clendenen, Captain Robert D. DeButts, and Captain Paul Greiwe.
2. Reinforcing Incisor Bands. Dr. Hugh A. Sims.

   The lingual surface of incisor bands must be reinforced to combat etching of the teeth.

3. To be announced. Dr. E. B. Pulliam.
4. To be announced. Dr. John B. Halet.
5. To be announced. Dr. Leo A. Rogers.
6. Simplified Setup Analysis. Dr. J. Byron Smith.
   A simplified method of making a setup analysis for diagnosis and treatment good. Elimination of cutting and sawing and loss of vertical dimension are the main advantages.
7. Cervical Anchorage. Dr. Travis Lanham.
8. Quick-Made Acrylic Retainers Without Investing. Dr. Paulus Hofheinz.
9. A Simple, Versatile, and Effective Retainer. Dr. Howard H. Dukes.
10. Palliative Orthodontics. Dr. William N. Flesher.
    Palliative by definition means "to reduce severity of," which borders on preventive orthodontics.
11. To be announced. Dr. Byron Coward.
12. Rotation Methods. Dr. Arthur Bostick.
13. Two Treated Cases, One With Extractions, One Without, Using the Edgewise Arch. Dr. Harold Born.

OFFICERS

President

Dan C. Peavy — San Antonio, Texas

President-Elect

Clarence W. Koch — Little Rock, Ark.

Vice-President

Marion A. Flesher — Oklahoma City, Okla.

Secretary-Treasurer

Fred A. Boyd — Abilene, Texas

Testimonial Dinner

A testimonial dinner honoring Thomas Gunter Duckworth, D.D.S., and Paul Guy Spencer, D.D.S., was held at the Gunter Hotel, Monday Evening, October 27.

Guy M. Gillespie was toastmaster.

Speakers were: Dan C. Peavy, President, Southwestern Society of Orthodontists; D. C. McRimmon, President, Texas State Dental Society; Brooks Bell, President, American Association of Orthodontists; Oren A. Oliver, President, Federation Dentaire Internationale.

Reception and Dinner Dance

A reception and dinner dance honoring President and Mrs. Dan C. Peavy was held at the Gunter Hotel, Tuesday Evening, October 28.

University of Toronto, Faculty of Dentistry

The University of Toronto, Faculty of Dentistry, is offering a continuation course in cephalometrics during the three-day period, Jan. 26 to Jan. 28, 1953.

Pacific Coast Society of Orthodontists

The Twenty-third General Meeting of the Pacific Coast Society of Orthodontists will be held at the Palace Hotel, San Francisco, on Monday, Tuesday, and Wednesday, Feb. 23, 24, and 25, 1953.

University of Pennsylvania

The Thomas W. Evans Museum and Dental Institute of the School of Dentistry, University of Pennsylvania, Philadelphia, Pa., will give a postgraduate course on the philosophy and principles of the Universal appliance. The course will be conducted by Spencer R. Atkinson from April 13 to 18, 1953.

A course on the twin wire mechanism will be given by Joseph E. Johnson, April 6 to 10, 1953, at the University of Pennsylvania.

University of Washington, School of Dentistry, Department of Orthodontics

The University of Washington announces that it is receiving applications for its next graduate class in orthodontics, which will begin the latter part of September, 1953. This course leads to a Master of Science degree, or Certificate for qualified candidates. Additional information may be obtained by writing the Director of Graduate Dental Education, University of Washington, School of Dentistry, Seattle 5, Wash.

Washington University School of Dentistry

Washington University School of Dentistry, St. Louis, Mo., offers the labiolingual technique course for orthodontists Feb. 16 through Feb. 28, 1953.

It will be composed of lectures on fundamental orthodontic problems and laboratory assignments in construction of appliances, including the occlusal guide plane. In addition to practice demonstrations of these principles, students will be required to construct a minimum of five sets of appliances for patients from their own practice. Details will be given those accepted for the course.

The course will be under the direction of Oren A. Oliver, D.D.S., LL.D., assisted by Boyd T. Tarpley, B.A., D.D.S., Harold K. Terry, B.S., D.M.D., William H. Oliver, D.M.D., and Frank P. Bowyer, D.D.S.

The course will be held at 4559 Scott Ave., St. Louis 10, Mo.

New York University College of Dentistry

The New York University College of Dentistry is offering a postgraduate course in orthodontics to graduate students or practicing dentists in 1953.

MISS CATHERINE IOZZO, SECRETARY,
Postgraduate Division,
New York University,
College of Dentistry,
209 East 23rd St.,
New York 10, N. Y.

Honoring Two Noblemen of Dentistry*

The Southwestern Society of Orthodontia honored Dr. Thomas Gunter Duckworth, and Dr. Paul Guy Spencer, San Antonio, Gunter Hotel, October 27, 1952, with a testimonial dinner.

Drs. Duckworth and Spencer have been active in the affairs of dentistry since their graduation from dental school. They are charter members of the Southwestern Society of

*Reprinted from the Texas State Dental Journal, October, 1952.

Orthodontia, having been instrumental in the promotion and establishment of this society. Their names are synonymous with dentistry and orthodontia in particular.

They built well, subordinating personal ambition for the more enduring values of ethical dentistry. These two amiable leaders were often bruised along the early trails, but the going never became too rough to stampede them. Faith kept alive by hope and confidence was their guiding star. They always headed upstream.

Looking at these two stalwarts, one is reminded of Shakespeare—"In the faces I see the map of honor, truth, and loyalty."

It is most fitting that Southwestern Society of Orthodontia has the vision to realize the opportunity afforded for paying their respects to these two stalwarts. Drs. Duckworth and Spencer have been the recipients of many honors in dentistry, but the full measure of gratitude in the hearts and minds of their associates can be represented only in such tokens of esteem as this testimonial dinner.

This pair of dynamos have never been famous because of any ability to remain silent during a meeting of dentists, therefore this testimonial dinner will be an interesting experience, when everyone present can talk, while these two notorious argufiers just sit and listen.

Notes of Interest

Dr. James C. Brousseau, orthodontist, announces the removal of his office to 1759 Government St., Baton Rouge, La.

H. Giddens King, D.D.S., M.S.D., wishes to announce the opening of his office, practice limited to orthodontics, at 713 First National Bank Bldg., Tuscaloosa, Ala.

Anthony J. Varco, D.D.S., announces the opening of his offices at 414 Porter Ave., Buffalo, N. Y., for the practice of orthodontics.

OFFICERS OF ORTHODONTIC SOCIETIES

The AMERICAN JOURNAL OF ORTHODONTICS is the official publication of the American Association of Orthodontists and the following component societies. The editorial board of the AMERICAN JOURNAL OF ORTHODONTICS is composed of a representative of each one of the component societies of the American Association of Orthodontists.

American Association of Orthodontists

President, Brooks Bell - - - - - - - - - - 4150 Mockingbird Lane, Dallas, Texas
President-Elect, James W. Ford - - - - - - - - 55 E. Washington St., Chicago, Ill.
Vice-President, Clare Madden - - - - - - - - 22 Lafayette Place, Greenwich, Conn.
Secretary-Treasurer, Franklin A. Squires - - - - - - Medical Centre, White Plains, N. Y.

Central Section of the American Association of Orthodontists

President, Paul G. Ludwick - - - - - - - - - - - - - Sharp Bldg., Lincoln, Neb.
Secretary-Treasurer, Frederick B. Lehman - - - - - - Merchants National Bank Bldg., Cedar Rapids, Iowa

Great Lakes Society of Orthodontists

President, Holly Halderson - - - - - - - Medical Arts Bldg., Toronto, Ontario, Canada
Secretary-Treasurer, Carl R. Anderson - - - - 402 Loraine Bldg., Grand Rapids, Mich.

Middle Atlantic Society of Orthodontists

President, George M. Anderson - - - - - - - - - - - 831 Park Ave., Baltimore, Md.
Secretary-Treasurer, Gerard A. Devlin - - - - - - - - - - 49 Bleeker St., Newark, N. J.

Northeastern Society of Orthodontists

President, George Callaway - - - - - - - - - - 654 Madison Ave., New York, N. Y.
Secretary-Treasurer, Oscar Jacobson - - - - - - - - 35 W. 81st St., New York, N. Y.

Pacific Coast Society of Orthodontists

President, Reuben L. Blake - - - - - - - - - 240 Stockton St., San Francisco, Calif.
Secretary-Treasurer, Frederick H. West - - - - - 760 Market St., San Francisco, Calif.

Rocky Mountain Society of Orthodontists

President, Curtis E. Burson - - - - - - - - - - 1232 Republic Bldg., Denver, Colo.
Vice-President, Kenneth R. Johnson - - - 311 E. Pikes Peak Ave., Colorado Springs, Colo.
Secretary-Treasurer, Don V. Benkendorf - - - - - 932 Metropolitan Bldg., Denver, Colo.

Southern Society of Orthodontists

President, Leland T. Daniel - - - - - - - - - - 407-8 American Bldg., Orlando, Fla.
Secretary-Treasurer, M. D. Edwards - - - - - - - 132 Adams Ave., Montgomery, Ala.

Southwestern Society of Orthodontists

President, Dan C. Peavy - - - - - - - - - - - 745 Milam Bldg., San Antonio, Texas
Secretary-Treasurer, Fred A. Boyd - - - - - - - - 1502 North Third St., Abilene, Texas

American Board of Orthodontics

President, Leuman M. Waugh - - - - - - - - - - - 931 Fifth Ave., New York, N. Y.
Vice-President, Raymond L. Webster - - - - - - 133 Waterman St., Providence, R. I.
Secretary, C. Edward Martinek - - - - - - - - - - - 661 Fisher Bldg., Detroit, Mich.
Treasurer, Lowrie J. Porter - - - - - - - - - - - 41 East 57th St., New York, N. Y.
Director, Ernest L. Johnson - - - - - - - - - - - 450 Sutter St., San Francisco, Calif.
Director, William E. Flesher - - - - - - - - Medical Arts Bldg., Oklahoma City, Okla.
Director, Max E. Ernst - - - - - - - - - - Lowry Medical Arts Bldg., St. Paul, Minn.

American Journal of Orthodontics

Official Publication of the American Association of Orthodontists,
Its Component Societies, and
The American Board of Orthodontics

VOLUME 38

JANUARY—DECEMBER, 1952

Office of the Editor: 8015 Maryland Ave., St. Louis
Published by The C. V. Mosby Company, St. Louis

Printed in the
United States of America

Press of
The C. V. Mosby Company
St. Louis

There is an apparent discrepan

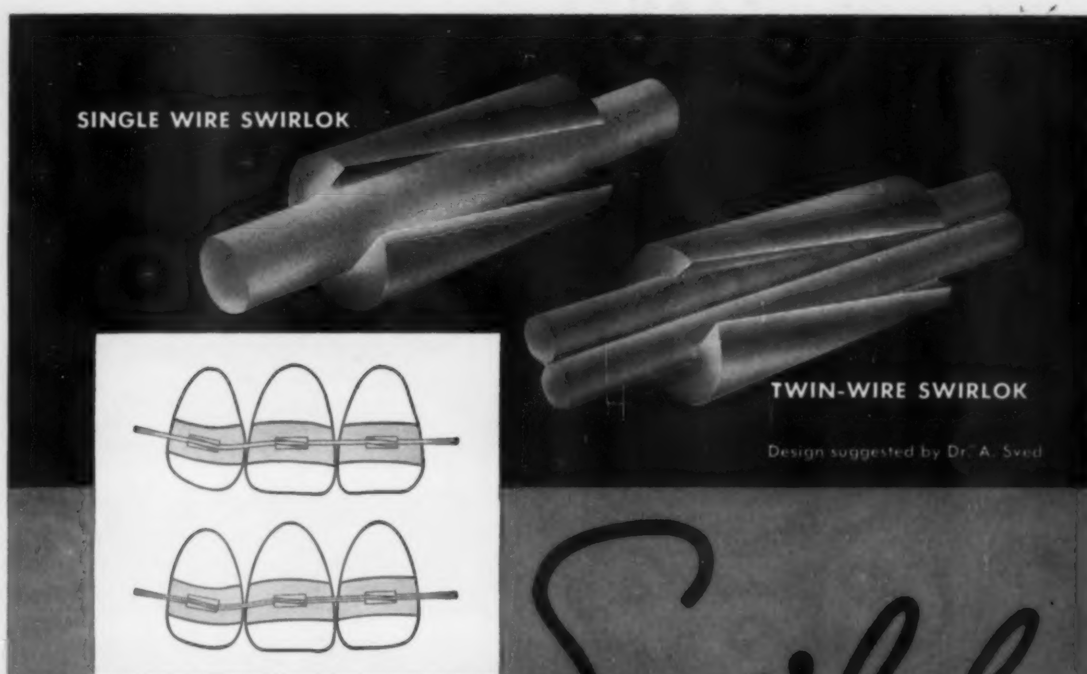
The pages are either missing o

The filming is recorded as the

ncy at this point.

or the pagination is incorrect.

e book is found in the collections.


SINGLE WIRE SWIRLOK
TWIN-WIRE SWIRLOK
Design suggested by Dr. A. Sved

cs

AMERICAN JOURNAL OF ORTHODONTICS

Published by THE C. V. MOSBY COMPANY, 3207 Washington Blvd.
St. Louis 3, U. S. A.

Entered at the Post Office at St. Louis, Mo., as Second-class Matter

Published Monthly. Subscriptions may begin at any time.

Official Publication of The American Association of Orthodontists, its component societies and The American Board of Orthodontics

EDITORIAL COMMUNICATIONS

Original Communications.—Manuscripts for publication and correspondence relating to them should be sent to Dr. H. C. Pollock, 8015 Maryland Ave., St. Louis 5, Mo., U. S. A.

Manuscripts should be typewritten on one side of the paper only, with double spacing and liberal margins. References should be placed at the end of the article and should include, in the order given, name of author, title, journal, volume, pages, and year; e.g., Smith, E. J.: Children's Dentistry, Am. J. Orthodontics, 34: 1-25, 1947. Illustrations accompanying manuscripts should be numbered, provided with suitable legends, and marked on margin or back with author's name. Articles accepted for publication are subject to editorial revision. Neither the editors nor the publishers accept responsibility for the views and statements of authors as published in their "Original Communications."

Illustrations.—A reasonable number of half-tone illustrations will be reproduced free of cost to the author, but special arrangements must be made with the editor for color plates, elaborate tables, or extra illustrations. Copy for zinc cuts (such as pen drawings and charts) should be drawn and lettered only in India ink, or black typewriter ribbon (when the typewriter is used), as ordinary blue ink or colors will not reproduce. Only good photographic prints or drawings should be supplied for half-tone work.

Books for Review.—Only such books as are considered of interest and value to subscribers will be reviewed, and no published acknowledgment of books received will be made. These should be sent to Dr. J. A. Salzmann, 654 Madison Ave., New York City.

Reprints.—Reprints of articles published among "Original Communications" must be ordered specifically, in separate communication to the publishers, The C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, Mo., U. S. A., who will send their schedule of prices. Individual reprints of an article must be obtained through the author.

BUSINESS COMMUNICATIONS

Business Communications.—All communications in regard to advertising, subscriptions, change of address, etc., should be addressed to the publishers, The C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, Mo.

Subscription Rates.—Single copies, $1.10. In the United States and other countries of the U. S. Postal Zone $10.00 per year in advance. In Canada and other foreign countries $11.00, single copies $1.20.

Remittances.—Remittances for subscriptions should be made by check, draft, post-office or express money order, payable to the publishers, The C. V. Mosby Company.

Change of Address.—The publishers should be advised of change of subscriber's address about fifteen days before the date of issue, with both new and old addresses given.

Advertisements.—Only articles of known scientific value will be given space. Forms close first of month preceding date of issue. Advertising rates and page sizes on application.

Bound Volumes.—The Book Shop Bindery, 308 West Randolph Street, Chicago 6, Illinois, will be glad to quote prices for binding complete volumes in permanent buckram.